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Making Gravel Concrete Fire-Resistant

FOR years there was long argument as to the relative strength of gravel and broken stone concrete. Many figures were advanced on both sides, but in time it became well established that no superior strength could be claimed for either aggregate. As much cannot be said for the fire-resisting qualities of concrete made from the two materials. The tests of the Bureau of Standards, reported by Mr. Hull at the American Concrete Institute meeting and abstracted on other pages of this issue, are confirmed by several conflagration experiences on both sides of the Atlantic. Gravel, particularly siliceous gravel, tends to pop under extreme heat, and concrete made of it may be expected to disintegrate at conflagration temperatures. There are places, however, where gravel is about the only aggregate possible. For such localities the Bureau of Standards has been making studies of plaster coatings; in other words, gravel-concrete columns are being fireproofed. So far the results have not been conclusive, but indications are that the necessary additional protection can be achieved by slight increase in cost. Favorable results may be had in the use of some kind of a plaster or mortar form in which the column can be poured and which remains in place as the fire protection for the column itself. The economic results of such a detail, as well as the fire-resisting qualities of the column so protected, will be looked for in the reports of next year's tests.

Wanted—Better Distribution of Food Products

BETTER distribution of farm and other produce is believed by many to offer the only solution of the problem of the high cost of living. It has been suggested that the use of the motor truck, with one terminal at the farm and a coöperative merchandising medium in the city, would not only give the farmer more for his products, but also make a large reduction in the cost of that produce to the consumer through the elimination of middlemen's profits. While well established city market terminals, where the farmer may rent space for selling purposes, may not entirely meet the requirements of a proper merchandising medium directly from producer to consumer, they would help toward solving the problem. Now that the motor truck has proved its utility for such work, why not establish motor terminals in many sections of the large cities, as suggested on p. 38 of our issue of July 3, 1919. This would eliminate some of the freight-terminal charges, and cartage from terminals to salesrooms and thence to consumers. There can be no doubt that several well equipped terminals with sales sections, cold storage facilities, etc., would materially lessen the cost of foodstuffs in our metropolitan centers. The cost of handling has been demonstrated in many instances to be twice or three times the total price received by the farmer.

Typhoid and Suicide Deaths

BY COINCIDENCE the death rates from typhoid fever and from suicide in the registration area of the United States were each 13.4 per 100,000 in 1917. Low as is this figure compared with the earlier typhoid rates, it is still so much higher than it would be if well known personal and public measures were generally adopted, that the rate may be said to partake of both suicide and murder—the latter through contributory community negligence. This view is strengthened when it is remembered that many cities and towns easily maintain a typhoid rate that is far below this average and is constantly falling, so the average means a much higher rate for many places. Every city that has not attained a typhoid rate of 5 per 100,000 should aim to reduce its rate to that figure, and those which have reached that goal should place the mark at 3 or 2 or 1, according to their standing.

More Authority for Engineers

A SORE spot in the relations of engineers to the public is touched upon in the letters by F. A. Churchill and "A Practical Engineer" published in our issue of July 3, 1919, pp. 37 and 38. The practice of delegating engineering authority to persons without engineering knowledge is too common in public work in this country. As regards paving work, it is a matter of common knowledge among material men and others who deal constantly with public works officials that often the engineer stands in the anteroom while inside a board consisting of grocers, blacksmiths and shoemakers confers, hears various arguments and selects the type of pavement, without recourse to engineering advice. In a great many cases, this is carried still further, particularly in municipal work, and the council, willing to dodge responsibility for a selection, allows the decisions to be made by local preferences through petitions of the abutting property owners or otherwise. Moreover, this practice is often fixed by state and municipal laws. While elected city officials are seldom qualified to make such selection, the general public is much less qualified, and the futility of such petitioning has often been demonstrated. It is not uncommon for one material interest to father a petition to property owners abutting on a street and get as much as 90% of the frontage, and then, during the succeeding week, another material interest steps in and obtains signatures for its material from 75 to 80% of the same frontage. This only demonstrates the fact that a loquacious material man can twist the property owner around his fingers. Under such conditions, it is manifest that the abutting property owner does not know what he wants. Common sense would indicate that one who does know—the qualified engineer—should be clothed with final authority on all engineering problems.

Overhead Exceeds Cost Plus 10 Per Cent

WHY contractors are averse to doing extra work under a contract which limits their compensation for this work to the net cost of labor and materials plus 10%, is indicated by the overhead cost figures given by A. P. Roscoe on p. 89 of this issue and p. 1164, June 12, 1919.

These costs, as cited, all relate to elevated-railway construction in New York City and were doubtless increased somewhat by delays due to war conditions and to other causes. They, however, indicate clearly enough that the contractor who does extra work for 10 or even 15% more than the net cost of labor and materials is fortunate if he must not dip into his pocket to meet some portion of its cost to him. This should not be.

Ignorance of the magnitude of overhead expenses and uncertainty in the practice of recording them are the reasons for the low percentages over the direct cost which most specifications allow the contractor for extra work. Unfortunately, contractors themselves are often not as certain about their overhead costs as they well might be. More often they take every means possible to conceal these costs. Yet it is plain that if the engineer is to be convinced that he is underestimating overhead, the contractor must be certain of his figures and must write them down plainly for the engineer to read, as has been done in the articles to which reference has been made.

Voting Membership Qualification in Local Engineering Societies

IN THE statement of Dr. Charles Warren Hunt (found in part elsewhere in this issue) which is being sent out by the American Society of Civil Engineers with the report of the development committee, there is expressed an idea that should have very careful consideration. He proposes that the *voting membership* of local and sectional societies be limited to those who hold membership in any grade in any national society of engineers.

The fundamental character of the suggestion lies in the fact that it is a method for securing the adoption by all engineering societies of the standards adopted by the nationals.

There can be no doubt regarding the desirability of the general adoption of the very highest standards by all engineering societies. Moreover, standards of membership are attained not by the writing of constitutions and by-laws, but by their administration, by the strictness with which the electing boards interpret the meaning of the written word. The loose interpretation and the variation of interpretation to be expected in different communities would be avoided by the method proposed by Dr. Hunt.

At the same time his plan might bring measurably nearer the making of a definition of what constitutes an engineer. If all locals demanded for voting privileges that a man be a member of a national society it would be obvious that there would be general acceptance in the profession of the statement than an engineer is one who is a member of a national engineering society or who has the qualifications for membership.

As put by Dr. Hunt, the suggestion obviously involves a compromise—and one that may be necessary in order that the idea may get wide acceptance or even discussion. We do not concede that juniors and associates in the national societies are engineers, nor is it likely that we could permanently stand back of a proposal that would endow juniors and associates with such standing. Standards, however, are progressive. For the time being it might be desirable to let all be voting members of the locals who held national membership in *any grade*, but were the idea accepted it would seem inevitable that there be a later step by which voting membership in the nationals would be necessary for voting membership in the locals.

It is obvious that there would be another advantage in the plan—the closer tying together of the whole profession.

Of course the suggestion will meet with opposition. It runs exactly counter, for example, to the proposal that one of the requisites for membership in a national society be membership in a local. Nevertheless, both suggestions are made with the same end in view—the strengthening of the local. The one, however, lays great stress on the quality feature—a thought, now that war is over, which is again getting greater attention.

The Motor Truck and the Railway

EVERY engineer interested in transportation questions—and what engineer is not?—will be repaid by a study of the special report in this issue on the relations of the railway and the highway as means for economic transportation. As the report shows, this question is not one capable of a single answer. The problem should be studied and solved by engineers for each individual locality. The report presents a solution for a typical case and gives the information and general principles which should enable a competent engineer to determine which transportation system will be most economical for a specific location.

In considering the rival claims of the railway and the highway as means of solving the transportation problem it is always well to recall that terse and significant definition of an engineer given by E. H. McHenry many years ago: "An engineer is a man who makes a dollar earn the most interest." That definition originated in railway location, where it was customary, in work under Mr. McHenry's direction, to compute the saving in operating expenses that would result from a given reduction in the grades of a railway line. The same principle should be applied in studying the question, what sort of a transportation line in a given location will render the service desired at the lowest cost. If engineers competent to make such studies are given the necessary authority, they can effect an enormous saving in expenditures for the further development of transportation.

There is now more reason than ever before why, in the public interest, the rule that transportation development should be undertaken only on the basis of careful engineering studies should be established. The cost of a large part of this transportation development seems likely to be met hereafter from the public treasury. Where such work is done by private enterprise somebody must show that the work will pay before capital can be secured; and in order that a work shall pay, it must be of public benefit somewhere in proportion to its cost. But when work is to be paid for by public funds this safeguard is taken away. In very few cases is any computation undertaken to determine

whether the work will be worth while. The engineer is not called in until after a decision to build has been made. His ability to render the largest public service, by finding how the public's dollar may earn the most interest, is rarely utilized. There is a large field for educational work here in order that the potent force of public opinion may demand and secure the best engineering services available to guide all expenditures of public funds for transportation service.

The investigation noted in the opening paragraph demonstrates that the extension of our railway network is greatly needed, notwithstanding the coming of the motor truck. Although the field of the motor truck is enormous, its chief function is to supplement the railway service rather than directly compete with it (see *Engineering News-Record*, Jan. 16, 1919, p. 120). The development of both railway and truck service, moreover, needs to be studied from new angles. For instance, the value of the service rendered by the branch railways carrying light traffic has never been fully appreciated. It might well be given careful study.

Other points suggested by our survey of the rival claims of the motor truck and the railway might be discussed here but so many of them are considered at length in the article already mentioned that in conclusion only one further remark will be made. It is that the motor truck service needs a better business organization, more complete knowledge of costs, and public regulation sufficient at least to prevent ruinous competition and the rapid destruction of roads provided at public expense.

Bridge Specifications and Stress Reversal

STUDY of the best current bridge-design specifications, such as those summarized in a comparative table in our issue of July 3, p. 33, reveals a distinct element of doctrine founded on the convictions of former days rather than on what is today regarded as established fact. This is prominently exemplified by the clauses governing the dimensions of members subjected to stress reversal. The rules require that such members be made much heavier than would suffice for any stress they will be called upon to carry; curious as it may seem, they must be proportioned to bear safely not only the full stress which comes upon them at any particular moment, but in addition a large part of the stress which existed several seconds (or minutes) previously. In effect, it would seem, the rules make an allowance for time-lag of stress.

It is probable that these reversal clauses originated, years ago, in a desire to secure protection against "crystallization" of metal, or fatigue effect—that is, against the supposed greater susceptibility of the material to failure under repeated or alternated stresses. The crystallization hypothesis has been so thoroughly discredited that it may be said to have been out of existence for a score of years at least. Fatigue ideas have recently been revived, it is true, but in the guise of a laboratory fiction, and their application, if any, is to machinery whose parts are expected to outlast many hundreds of millions of stress repetitions, and not at all to bridges. Yet the stress-reversal clauses have held their place in bridge specifications throughout the changes of scientific thought; specifications of fifteen years ago contain them, as do those of today.

The mechanical and structural mind probably has an inherent tendency to believe in a lag of stress-strain actions. Every practical experience teaches something of slow recovery from deformation, suggesting the existence of a slight amount of viscosity, or perhaps plasticity, in our constructional materials. And it is natural to believe that such delay in recovery from strain calls for some allowance in the way of more ample proportioning. It is far from certain, however, that such ideas have application to the low stresses and gradual reversals that are found in bridge members.

Unfortunately, another circumstance affects the life of the bridge members which are subject to stress reversal, and for this reason it is difficult to estimate how much influence the lag idea exerts. The members in question, it happens, are precisely the ones on which increase of live load has most serious influence. Because of the continuous increase of train weights in the course of railway development, the whole history of bridge construction constitutes a record of bridges made obsolete by growth of traffic loading. When the moving loads become heavier, the web members are affected in a degree out of all proportion to the load increase, since one of the stresses which they must withstand is the difference between a dead-load and a live-load effect. Therefore it has been true that any rule of design which made reversed-stress members heavier than simple principles of proportioning would require operated to lengthen the probable life of the bridge. This well understood fact doubtless was an influence, and may have been the chief influence, in the perpetuation of the reversed-stress clauses.

Independent provision for increase of live load is made in some of the best specifications, and the wisdom of such provision is obvious enough to require no comment. Once this point is taken care of adequately, the matter of stress-reversal stands on its own merits, and the retention of reversal clauses alongside those providing for live-load increase is therefore significant. Since no test evidence showing deterioration of bridge members under repetition or alternation of stress has been brought forward, it must be concluded that these clauses have survived because of a decided belief on the part of bridge engineers in the harmful nature of stress

r hysteresis, or fatigue, which ever name is pre-

cifications are not so phrased that the reasons rlying their several provisions are directly evident. This makes more difficult the problem of reaching the desired clearness and definiteness in the matter under discussion, since it involves separate action on such matters of importance as impact, the possibility of future live-load increase, and the deterioration of material under repetition of stress. Years ago these widely different matters were lumped into a single allowance. Great progress has already been made in providing separately for impact and for live-load increase; it remains to complete the work by independent and adequately reasoned consideration of "fatigue."

In the present state of structural knowledge, it is hardly open to doubt that separate effects bearing on strength and safety should be separately and explicitly provided for. Where one purpose is masked by another, or where overlapping effects (to coin a term) are dealt with in blanket fashion, the resulting lack of clearness may reduce the efficiency of design, and may even reduce safety.

The Relative Economy of Freight Transport by Railway and by Motor Truck

By Charles Whiting Baker
Consulting Editor, "Engineering News-Record"

THE greatest opportunity for raising the efficiency of the country's transportation lines lies at the terminals.

Hauling goods to and from railway stations and on light-traffic railways now costs ten to a hundred times as much per ton-mile as movement over trunk-line railways.

The motor truck finds its greatest advantage at the city ends of the railway network, because it can carry goods from origin to destination, eliminating rehandling and heavy railway terminal costs.

At the country ends of the railway network, there are locations where competition between the railway and the motor truck becomes possible, and the cost of each is here investigated, including in each case the cost of the roadway used.

For hauling between terminals, where the volume of traffic is sufficient, the railway can handle freight at a small fraction of its cost by motor truck. Thus, the motor truck has not made the light-traffic railway obsolete, as is often supposed. On the contrary, such lines should be improved and greatly extended. The motor truck in country districts has still a large field where its ability to climb steep grades, to use the public highway instead of a private right-of-way, to cut out rehandling at terminals, to collect local business, and to collect, haul and distribute loaded trailer wagons, places it in a different class from the railway as a tool of transportation.

Better business organization and more economical methods of operation are needed for both the light-traffic railway and the motor-truck line. The services of engineers should be utilized to determine the most economical system for a given location and the most efficient methods for its operation.

I. The Light-Traffic Problem: Its Important Relation to the Public Welfare

UPON the efficiency of the transportation machine in America depends in great measure the future prosperity of the nation." Thus wrote Director-General McAdoo in a letter to Congressman Sims just before resigning his office. Every economist and engineer, at least, will appreciate the truth of this statement.

It is not yet a century since the railway era began. The economic and social changes of that century which have resulted from the railway, and would have been impossible without it, are far greater than those which occurred in all previous time since the dawn of history. The railway has become an economic necessity.

But "the transportation machine," referred to by Mr. McAdoo, means not alone the railway but the whole chain of transportation from the original producer to the final consumer. The cost of transportation is a tax which must be added to the price the consumer pays for every product, or deducted from what the producer receives. This tax is laid on every individual. It enters into every business transaction. It influences the wages that can be paid to workmen. Upon the size of this tax depends the opening of new markets, the establishment of new industries, the outreach to new sources of food and raw materials.

And now for the important and little comprehended fact with regard to this transportation tax. *The great opportunity for its further reduction lies at the terminals.* The statement that the railway has annihilated distance is not a mere figure of speech. It costs today as much to haul a ton of farm produce ten miles to a railway station as it does to haul it a thousand miles over a heavy-traffic trunk-line railway. It often costs more today to transport a ton of merchandise from its arrival in a long train in the freight yard on the outskirts of a great city to its deposit in the warehouse of a merchant four or five miles away, than it has cost to haul it over a thousand miles of railway line.

These statements may seem incredible to many, and it is well to support them by actual figures. Taking in each case the cost of hauling alone and omitting the charge for use of the road over which the haulage is done, the cost of hauling farm produce over country highways was not less than 25c. per ton-mile under normal price conditions before the war, and it has risen since. The cost of hauling freight over the road on trunk-line railways of heavy traffic, apart from terminal expenses, was not over 2½ mills per ton-mile in 1916.*

Let us understand the significance of these figures. They show that the farm or mine or mill which has to haul its products more than 10 miles to a railway shipping point is by that short distance made as remote from its market as Illinois is from New York City. They show that the producer 20 miles from a railway

*The operating expenses of railway companies reported to the Interstate Commerce Commission lump together those of the light-traffic branches and the heavier-traffic main lines. By selecting companies which have a small mileage of branches in comparison to their extent of main line, it is possible, from the Interstate Commerce Commission statistics, to obtain a fair idea of the cost of moving freight over the road on heavy-traffic lines. This has been done for a few selected roads in the accompanying table. By applying the percentage of operating expenses to gross earnings to the average earnings per ton-mile, there is obtained the average cost of hauling freight per ton-mile given in the last column. These figures, however, *include the terminal expenses* of the railway as well as the cost of hauling over the road. The Hon. Robert W. Woolley of the Interstate Commerce Commission in a recent statement before a Senate Committee showed that of the total operating expenses of the railways of the United States one-third is chargeable to operations in railway terminals. Deducting one-third from the figures in the last column of the table, it will be seen that the average costs fall considerably below 2 mills per ton-mile. Were it possible to obtain figures of the cost of main-line operation alone, apart from the branches, for such trunk-line railways as the Pennsylvania R.R. or the New York Central R.R. they would doubtless show equally low costs.

Name of Road	Miles Operated	Revenue per Ton-Mile Mills	Per Cent. Operating Expenses to Earnings	Cost per Ton-Mile Mills
Bessemer and Lake Erie	204	4.50	51.87	2.33
Western Maryland	688	5.01	64.40	3.22
Chicago & Erie	269	4.38	61.41	2.70
Hocking Valley	350	4.06	66.84	2.68
Toledo & Ohio Central	575	4.00	74.59	2.98
Kanawha & Michigan	176	3.82	62.77	2.39
Chesapeake & Ohio	2,385	3.80	65.90	2.50
Norfolk & Western	2,085	4.20	56.16	2.35
Virginian Ry.	505	3.40	53.02	1.77
Carolina, Clinchfield & Ohio	283	5.82	49.80	2.90
Chicago & Alton	1,052	6.18	71.07	4.39

line has a transportation tax of at least $5 per ton on all the goods he sends to market in competition with the producer near the railway station. That means a lower price for every bushel of wheat or corn, for every bale of cotton, every quart of milk. It means that the world can only draw its supplies of food and minerals and raw materials from regions which have been penetrated by the railway.

The figures here set forth also make clear another important fact. We cannot expect to reduce much further the cost per ton-mile of freight movement on heavy-traffic railway lines. The genius of the ablest engineers in the profession has been concentrated on this task for half a century, and their achievements are one of the miracles of modern times. The opportunity for further reductions of cost lies at the terminals.

Terminal Costs Have Increased

While the cost of hauling freight over the railway has been steadily going down, the cost of handling freight in terminals at the city end of the line has been rising as steadily. A large part of this increase has been an inevitable result of the growth of cities. The Pennsylvania R.R. Co. operates as large a mileage of yard track and sidings as it does of main line. These yard tracks occupy lands worth several times as much as the lands over which the main lines run. The New York Central R.R. Co. has one-third as many switching locomotives as locomotives in freight service.

Much larger than the terminal costs borne by the railway are those borne by the shipper and receiver of goods in large cities. The cost of handling goods from the railway car to the consumer in a great city is today one of the biggest items in the transportation tax.

And at the country ends of the railway network the cost of transportation has also risen. It costs today more per ton-mile to haul freight over the highway than it cost a century ago.

The Light-Traffic Railway

The problem before us relates not merely to the transportation to and from the railway station. It has to do with the light-traffic branch-line railways, on which the cost of hauling freight per ton-mile is often ten to twenty times as great as on the heavy-traffic railways. Almost without exception, these light-traffic railways do not pay. Their construction has come to a stop. Investors will not furnish money to build them, and the great railway companies also have ceased to build branch lines. There has been an awakening to the fact that such extensions are generally a burden on rather than a benefit to the company.

The railway network of the United States, instead of being extended, is actually being reduced. A large mileage of railway lines has been abandoned during the past three years. The owners of moribund properties have taken advantage of the abnormally high prices for second-hand rails and rolling stock to save something from the wreck of enterprises for which high hopes were once entertained.

Who knows what the effect has been on the communities which relied on these abandoned lines for transportation? How have their farms and industries fared when thrown back upon the highway for transportation? If these communities are injured, if their products are shut out from market, the matter is one of public importance; but at present it is nobody's business, in either Federal or state government, to inquire into this. Government authority over the railway has been plentifully exerted to regulate and restrict; but not since the early days of the railway era has it been recognized that the Government should aid the development of such transportation facilities as a boon of enormous public benefit.

Good Roads and Motor Trucks

There is a widespread belief that the good road and the motor truck are destined to supersede the light-traffic railway. The motor truck for freight transporta- is now carrying on a lively competition with the railway in handling merchandise freight on many routes.

While the building of branch-line railways is at a standstill, the building of good roads is proceeding on an enormous scale. Bond issues of $50,000,000 and $60,000,000 for good roads have been approved in Illinois and Pennsylvania; and other states are following.

At the same time, the motor-truck traffic is doing damage to good roads already built which will require many million dollars to repair. It is agreed that roads must now be built heavy enough and costly enough to withstand motor-truck traffic. This means, even with prices reduced to the same basis, a cost per mile for construction probably at least four times as great as the cost per mile of the standard macadam road in general use in the United States a quarter century ago, previous to the advent of the automobile.

Fields of the Railway and the Motor Truck

It is surely, then, worth while to investigate from an impartial standpoint the relative economy of the railway and the highway. It is obvious, of course, that each has a field in which it is supreme; but in the field where they do compete with each other it is important that investigation should determine the relative economy.

There is, of course, no possible competition of the highway with the railway in hauling low-class freight over long distances. Railway average freight charges on lines of heavy traffic range from two mills to six mills per ton-mile. Motor-truck average hauling costs are 12c. to 25c. or more per ton-mile, and this does not include, as in the case of the railway, the interest and maintenance charge on the road which the motor truck uses.

This comparison of ton-mile costs between the motor truck and the railway, however, is incomplete, because the motor truck renders a service that the railway cannot. The motor truck can carry goods from origin to destination without rehandling, and this eliminates the cost of hauling the goods to and from the railway station at each end of the journey and the cost of rehandling there.

It is in this elimination of terminal costs and rehandling that the great advantage of the motor truck lies. This advantage insures it an enormous field of usefulness even though its costs per mile of haul are many times that of the railway.

Furthermore, because terminal costs to the railway and shipper are highest at the large cities, it is evident that the motor truck finds its largest field of usefulness

there rather than at the country terminals of the railway network, where the terminal costs are comparatively low.

Again, since the terminal costs to both railway and shipper are highest on merchandise, especially when shipped in less-than-carload lots, it is this class of freight that will gravitate to the motor truck. On the bulk freight shipped in carload lots, which makes up the principal tonnage of railway traffic, the motor truck cannot possibly compete. The railway is supreme, too, in handling carload freight, or even less-than-carload, where it can run its cars directly into a manufacturing plant or a warehouse and often not merely reduce its own terminal costs to a very small figure, but the cost of transport within the plant itself.

On the other hand, the motor truck has an advantage which will doubtless be responsible for a great increase in the use of trucks, in being able to reduce the cost of packages. On many classes of merchandise the cost of the cases and packing necessary for rail transport is much more than the freight charge over any moderate distance. If a factory or a merchant can distribute goods by motor truck and deliver them direct to destination, the cost of packages can frequently be cut to a very low figure.

A further advantage which is responsible for a great diversion of business from the railway to the motor truck is the promptness of delivery. Goods shipped by motor truck from New York to Philadelphia are put on the truck in the afternoon, carried to Philadelphia during the night and delivered to the consignee there before noon next day. If the same goods are shipped by rail, the railway also gives a daily service. The goods are put on board a car during the day and the car will be hauled to Philadelphia during the night. There are in that city, however, over 50 local freight stations of the Pennsylvania R.R., and it may be one to three days before the car is switched over the maze of terminal tracks so as to land the goods at the station nearest to the consignee's warehouse. Then a notice of the arrival of the goods has to be mailed to the consignee. On receipt of this he orders a truckman to go after the goods. By the time they are delivered it will probably be at least five days from the time they were started. This is typical of the quickest delivery practicable with rail shipments. On routes where direct car service is not furnished, or is furnished only on certain days, a shipment may take a week or two for a journey of a hundred miles.

Comparing the Cost of Railway and Highway Traffic

There have been repeated published expressions of a desire for a complete and accurate comparison of the cost of railway transport and of highway transport. Those who express such a desire probably have failed to realize that no statement of costs is possible which will be generally applicable. The cost per ton-mile on any transportation line is bound to vary enormously with the tonnage moved, with the character of the traffic and with the local conditions. The only way in which to determine the relative cost of highway and railway transport is to assume a specific case and estimate the cost on each system as applied to that case.

There is no question that motor-truck traffic in the vicinity of the great cities is here to stay. There is a question, however, whether the railway or the highway is in future to be preferred for railway feeder lines in country districts. It is worth while therefore to compare the cost of moving traffic in such a location by each system.

In making this comparison, each system must be charged with the cost of building and maintaining the roadway to be used, as this is obviously the only correct basis, although in the ordinary competition of motor trucks with railways, the truck has the advantage of having the road it uses built and maintained by the taxpayers.

Relation of Traffic Density to Type of Road

The most important element in fixing the economic type of road is the volume of traffic to be handled. Obviously, the volume of traffic may be so small that an earth road will show the lowest total cost. A heavier traffic may warrant the building of a narrow gravel road. A still heavier tonnage will call for a pavement fit to stand motor-truck travel, and, finally, a volume of traffic will be reached that will make the railway the only really economical carrier.

The proper unit for measuring density of traffic is the tons moved over the road annually, since this eliminates variations in volume of traffic at different seasons of the year. Since the tonnage moved may vary on different parts of the road, the average density for the whole road is determined by dividing the total ton-miles for all the freight carried by the number of miles of road affected. We thus obtain the familiar traffic-density unit of railway statistics, "ton-miles per annum per mile of road."

In the comparison below, the traffic density assumed is 25,000 ton-miles per annum per mile of road, which is equivalent, of course, to the passage of 25,000 tons over the road from end to end. Let us see what such a traffic density means.

If we assume that there are 300 days of traffic movement per year, the average tons per day will be 84. If we assume, further, that two-thirds of this traffic is carried in one direction and one-third is carried on the return trip, 56 tons per day on the average will be carried one way. If this were moved in two-ton, horse-drawn wagons, 28 such wagons would pass a given point daily, going one way. If moved in five-ton motor trucks, fully loaded, there would be 11 such trucks each way daily, or about one every hour of daylight. It will be obvious from the above that 25,000 tons per annum is a very light traffic compared with what many main highways are now carrying.

Topographic Conditions

In order to make such a comparison as we are attempting, it is necessary to estimate the cost of the roadway; and the cost of either a railway or a highway will of course vary within very wide limits according to the country in which it is built. It is necessary, therefore, to make an assumption as to the local conditions, and it will be assumed that the road is to be built through a favorable country, such as would permit the building, say, of a common earth road, at a cost for grading, ditching, culverts, bridges and fencing of $1000 per mile.

To summarize, then, the problem presented is to carry freight amounting to 25,000 tons per annum between a

railway station and a terminal ten miles distant, two-thirds of the freight being carried in one direction, and the country between being so favorable for road construction that a common road can be built at a cost of $1000 per mile. What will be the cost of moving it: (1) By a highway fit for motor trucks; (2) by a railway, and (3) by horses and wagons over the unimproved country road?

For the solution of this problem there must be determined for each type of roadway, first, its cost of construction; second, its annual expense for maintenance, and, third, the probable life of the roadway, at the end of which time it may be assumed the road down to the foundation course will require complete renewal. The life may also be influenced by the factor of obsolescense—the risk that through changes in population or other local conditions the traffic using the road may dwindle until its maintenance is no longer justified.

The annual cost of the road will equal the interest on the cost of construction, plus a sinking fund contribution which will repay the cost of the worn-out part of the road at the end of its life, plus the annual cost of maintenance. If we divide this sum by the number of tons per annum carried over the road, the quotient will be the cost per ton chargeable to the use of the road.

II. Highway and Railway Construction and Maintenance Costs

It is almost needless to say that experience in the use of heavy motor trucks on highways is too recent—and, it may be added, too destructive—to admit of any estimates on the cost of roads for motor-truck traffic that will not be challenged by many as either too low or too high. The writer, however, has obtained the opinions of leading highway engineers who have had most experience in building and maintaining roads subjected to heavy motor-truck traffic, and the figures below are based on these opinions.

One important element in the cost is, of course, the width to be adopted for the paved surface. Engineers are generally agreed on a minimum width of 18 to 20 ft. for roads to be used by heavy motor trucks. For the present purpose, however (comparing the motor-truck road and the railway), a single track motor-truck road, 9 ft. in width, is assumed. For the small volume of traffic here proposed, this narrow roadway can be made to carry motor trucks, with perhaps some provision for scheduling their movement and meeting at turnouts, which is no more than the railway has to do with its traffic.

Without doubt, the road as actually built would almost inevitably be given a much wider paved surface in order better to accommodate other vehicles. The cost of the additional width, however, should be chargeable to this other traffic and not the motor-truck operation.

As to the material for the paving, the opinion of engineers is now fairly well agreed that concrete, either as a foundation for a wearing surface or as the entire pavement, is essential for a road which is to endure motor-truck traffic. This means a cost of probably $2 per square yard if concrete is adopted or $3 to $4 per square yard for concrete covered with brick or asphalt, or a still higher price for granite or wood blocks. We will assume the lowest figure, giving a cost for the paving alone of $10,560 per mile. The grading, drainage and bridging of the road to the subgrade preparatory to the paving will cost much more than for a cheap dirt road, and $2000 per mile is little enough to allow for this in addition to the $1000 assumed as the cost of a dirt road on the same location. The total cost of the motor-truck road, then, will be 13,560 per mile.

The annual cost of maintenance is, further, assumed as $160 per mile and the life as 15 years, at the end of which time, it is assumed, the concrete will be covered with asphalt, the concrete becoming the foundation course. Doubtless, these figures will also be challenged. Concrete roads which have a much heavier traffic are being maintained at considerably lower cost per mile. On the other hand, the cost of annual maintenance may be expected to increase year by year as the concrete road grows older. The assumption of 15 years of life will be criticised as too short by many partisans of the concrete road; but the error, if it be an error, tends to make the concrete road a safe choice as against a pavement of still greater durability.

At the end of 15 years the concrete road should still be worth 75c. per square yard as foundation for a new pavement. The annual depreciation charge, then, will be the sinking fund contribution sufficient to accumulate $1.25 per square yard of road in 15 years. At 5% interest this will mean an annual sinking fund payment of about $300 per mile per year.

In most locations such as are here considered, a part of the first cost of the road might well be charged to the other vehicles which use the road, instead of placing it all on the motor-truck traffic. If desired, such an apportionment could, of course, be made, and also an estimate of the amount of maintenance and annual depreciation chargeable to each class of traffic. Since the present computation is intended chiefly to illustrate the method of making such determinations of road cost, it is deemed unnecessary to introduce such refinements of calculation here.

Cost of Railway Construction and Maintenance

The cost of railway building varies, of course, enormously, according to the kind of railway which is to be built and the local conditions of construction. In the present case, since the traffic to be handled is so very small, it will be assumed that the railway is located with liberal use of steep grades and sharp curves where necessary to cut down cost of grading. It will be assumed, further, that special light rolling stock is used, permitting the use of light rails and ties and cheap bridges and reducing the cost of track maintenance. In favorable country, where a common road can be built for $1000 a mile, such a standard gage railway line, may be assumed to cost $4000 per mile for grading, draining, bridging and all other expenses to the completed subgrade ready for track, in addition to the $1000 assumed as the cost of grading, etc., sufficient for a common earth road. The track may be assumed to add $5000 to this, or $10,000 per mile for the completed line. This estimate includes only the same class of construction items as enter into the cost of the highway for motor trucks just considered. Right of way and promotion expenses, for example, are not included.

Turning now to the cost per mile per annum for track maintenance, this is assumed at $500 per mile per annum. It is true that some railways of very light

traffic have under the stress of necessity maintained their tracks for a considerably lower figure; but the fact must be faced that railway ties and track labor, two of the largest items in the cost of track maintenance, will be considerably higher in the future than in the past.

It is not customary to make a separate charge for the depreciation of railway track, the usual assumption being that maintenance offsets all depreciation, as indeed it usually does. In the present case, however, a charge for depreciation is justified because of the risk of obsolescence. Such light-traffic railways are inevitably subject to the risks that, through changes in population or traffic conditions, they may become unprofitable and be abandoned. Any investor in such a proposition would be justified in demanding that the company should earn enough in addition to interest to repay the cost of the road in not more than 25 years. In this case obsolescence should be figured not merely on the track but on the entire cost of the line, $10,000 per mile. To provide thus for amortization of the cost of the road will require a sinking fund payment, at 5% interest, of $210 per mile per year.

Cost of An Earth Road

The first cost of an earth road in the given locality has already been assumed at $1000 per mile. What will it cost to maintain such a road with an average traffic over it of 25,000 tons per annum? As previously shown, this will require the movement over the road for 300 days in the year of 28 two-ton wagons each way daily, all loaded one way and half of them loaded on the return trip. Such an earth road, however, would in a large part of the United States be impassable by wagons with such loads during several weeks or months of the year, on account of mud or snow, so the business would have to be concentrated into probably not over 200 days of the year.

The cost of maintaining such a road would range from a very small sum in the arid regions of the West, or in other sections where the natural soil is adapted to roadmaking, to several hundred dollars per mile in sections where the road is built over sticky clay or deep swamp. For our present purpose we may take the cost of maintenance as $250 per mile of road per annum. The depreciation may be omitted, since the original cost of the road was only $1000 and the earth road, under the annual maintenance outlay above assumed, will be perpetually as good as or better than when originally completed, and hence no definite life can be assumed for it.

Comparison of Roadway Costs

We may now present in tabular form the cost of the different roadways and the cost per ton-mile *chargeable to the use of the roadway*, for each system of transport, as follows:

TABLE I. COSTS PER MILE OF ROADWAY

	Earth Road	Motor-Truck Road	Railway
Construction cost	$1,000	$13,360	$10,000
Annual interest charge at 6 per cent	60	813	600
Annual cost of maintenance	250	160	500
Annual sinking fund for depreciation		300	210
Total annual cost	$310	$1,273	$1,310
Cost per ton-mile for 25,000 tons per annum	1.34c.	5.09c.	5.24c

III. The Cost of Moving Traffic by Railway and by Highway

(A) *COST OF MOTOR TRUCK OPERATION*

Notwithstanding the great amount of traffic carried by motor trucks during the past three years, there is surprisingly little complete and accurate information available as to the ton-mile cost of freight haulage by motor truck. One reason for this is that very few motor-truck users have kept complete and accurate records of their costs. Emphasis may well be laid on the word *complete*. There are many partial cost records available. Of this class are most of those sent out by motor-truck manufacturers. When it comes to the items of depreciation and overhead charges the motor-truck operator often deceives himself as to the cost of carrying on his business.

The most detailed figures thus far published are those compiled by the Motor Truck Association of America. They appeared in *Engineering News-Record* of Feb. 27, 1919, p. 438, and are reprinted with the accompanying explanation as follows:

The cost of operating a five-ton gasoline truck, shown in detail in Table II. was prepared by one of the largest operators of trucks in the East, with the recommendation

TABLE II. COST PER DAY OPERATED FOR FIVE-TON GASOLINE MOTOR TRUCK BASED ON 50 MILES PER DAY PER TRUCK AND 300 DAYS PER YEAR

	Amount	Totals
Direct Charges		
Driver	$5.00	
Tires, based on present cost of tires (guaranteed basis)	3.00	
Oil, grease, kerosene, graphite, etc.	.50	
Gasoline, 3½ miles to gallon equals 14 gallons at 25c. per gallon, (average)	3.50	
		$12.00
Indirect and Overhead Charges		
Depreciation, 20% on $6,000 investment	$4.00	
Interest, 6% on $6,000 investment	1.20	
Insurance, averaged at $4.50 per year	1.50	
Garage, rental, upkeep, etc., $300 per year per car	1.00	
Maintenance, minor repairs, supplies, tire chains, tools, lamps, springs, spark-plugs, equipment, etc. (estimated)	1.00	
Overhaul, complete, pro-rated, $600 yearly	2.00	
License fee	.20	
Body upkeep, repairs and painting	.30	
		11.20
Supervision, based on 10% of above costs		2.32
Lost time—time lost in repairs, no work, weather, or other causes, 20% of total less gas, tires and oil, etc., $7		3.70
Total cost per day operated		$29.22

that it be sent out to truck operators, requesting them to criticise it and submit their own costs for the information of the association.

The table is based upon actual experience. It is assumed that the truck makes 50-miles per day and works 300 days per year. The direct charges are accumulating only while the truck is under operation, while the indirect are those which are accumulating whether the truck runs or not. Supervision includes all office expenses, stationery, printing, advertising, office help, telephone charges, outside men, etc. The cost of mechanical garage equipment, power, spare parts, etc., with interest on the same, and depreciation, is included in maintenance and overhaul.

Average operating conditions as to load were used in compiling this table. Up to the present time these have equaled a full load one way or, for a 50-mile day, transportation of 125 ton-miles at about 24c. per ton-mile. The costs are actual, no profit being included to cover risks, etc.

Table III. gives the costs as sent in by six trucking companies in answer to the inquiry. The averages shown in the last two columns include the figures in Table II.

In considering the returns, it will be noted that many of the differences are in such elusive items as overhead, supervision, and lost time. The averages in the last two columns were obtained by adding the amounts together and dividing by the number of reports on that item. The average total cost per day, while somewhat less than in Table II, in the main agrees with it very well.

The figures as given apply particularly to operation of trucks in large fleets, such as those employed by the interurban haulage companies. They were furnished by companies operating out of New York City

These figures will be more convenient for study if rearranged to show the overhead expenses in costs per year and the direct operation expenses in costs per mile, and to eliminate an inaccuracy due to the method used in computing the effect of idle time in Table III. Thus rearranged, the figures in Table II are as follows:

TABLE III. COSTS REPORTED BY SIX MOTOR TRUCK OPERATORS, COMPILED ON THE SAME BASIS AS THE COSTS IN TABLE I.

Truck Operator	A	B	C	D	E	F	Average	Total
Direct Charges, per Day								
Driver	$5.00	$5.20	$5.00	$5.00	$5.17	$5.50	$5.13	
Tires	3.00	3.75	2.00	2.00	2.00	3.00	2.68	
Oil, etc.	.30	.....	.30	.50	.25	.25	.35	
Gasoline	3.00	4.00	3.50	4.65	2.08	3.75	3.50	
								$11.66
Indirect Charges, per Day								
Depreciation	$3.50	$4.19	$3.60	$3.40	$3.67	$4.00	$3.77	
Interest	1.20	1.26	1.08	1.22	1.10	1.00	1.15	
Insurance	1.50	2.54	1.26	2.10	.86	.50	1.47	
Garage	1.00	1.20	1.00	1.00	.89	1.00	1.01	
Maintenance	.50	.....	.50	.....	1.00	.....	.75	
Overhaul	1.33	2.75	1.80	1.60	2.00	3.00	2.07	
License	.17	.27	.20	.20	.20	.20	.20	
Body upkeep	.25	.....	.30	.10	.40	.....	.27	
								10.69
Supervision	.50	2.93	2.05	1.90	.....	.....	1.90	1.90
Lost time	2.20	.....	1.67	3.40	2.50	1.97	2.57	2.57
Total	$23.45	$28.09	$24.26	$27.07	$22.12	$24.17	.....	$26.82

TABLE IV. OVERHEAD CHARGES PER YEAR FOR A 5-TON CAPACITY GASOLINE MOTOR TRUCK RUNNING AN AVERAGE OF 50 MILES PER DAY FOR 240 DAYS PER YEAR

*Driver's Wages	$1500
Depreciation (20% on $6,000 investment)	1200
Interest (6% on $6,000 investment)	360
Insurance	450
Garage (rental, upkeep, etc.)	300
Maintenance, minor repairs and supplies, tire chains, tools, lamps, springs, equipment, etc. (estimated)	300
Complete overhaul once a year	600
License fee	60
Body upkeep, repairs, painting, etc.	90
Supervision	696
Total per annum	$5,556
Overhead charges per day for 240 days in the year, actual operation	$23.15
Overhead charges per mile for 50 miles per day	46.30c.

Direct Charges Per Day and Per Mile for 5-Ton Truck Operated as Above

	Cost Per Day	Cost Per Mile
Tires (based on present tire guarantee)	$3.00	$0.06
Lubricants	.50	.01
Gasoline (3½ miles per gal., 14 gal. at 25c.)	3.50	.07
	$7.00	$0.14
Total of overhead and direct charges for 240 days per year operation, per day		$30.15
Per mile		60.30c.
Cost per ton-mile for full loads one way and empty returning		24.12c
Cost per ton-mile for full loads one way and half load returning		16c.

*In the above table the driver's wages have been placed under overhead charges because the driver is paid by the month and his wages continue even though the truck is idle because of repairs, bad weather or lack of business, unless, of course, the idleness should be of long duration, when the driver might be laid off.

Motor-Truck Traffic, New York and Philadelphia

One of the most-used routes for motor-truck interurban traffic is that between New York and Philadelphia. Half a dozen or more trucking companies are operating a daily service over this route, and numerous others send trucks over it more or less frequently, as business requires. Most of the business is done in five-ton trucks which make the run of about 95 miles in 9 to 10 hours, and with extra mileage to pick up freight average about 100 miles per day. The railway rate from New York to Philadelphia per 100 lb. varies from 33c. on Class I. freight to 14½c. on Class VI. freight. This rate on first-class freight is equivalent to $6.60 per ton, or for the 90-mile rail haul, 7.3c. per ton-mile. The motor-truck rate for small shipments is $1 per 100 lb., or $20 per ton. On larger shipments this rate is reduced, and some companies will carry full five-ton shipments for $65, or $13 per ton. If the total length of haul is taken as 100 miles, this last is equivalent to a rate of 13c. per ton-mile paid by the shipper. The service rendered by the motor truck, however, in order to be compared with that rendered by the railway, must have added to the railway charge the cost of transfer to and from the railway station at each terminal. At the lowest rate of $13 per ton charged for the shipment by truck, the shipper would pay $3.20 per ton for cartage at each end to make the total cost of the rail shipment equal the cost of the shipment by truck.

In competition with the express companies the motor trucks have a still better chance for profit. The express charge per 100 lb., New York to Philadelphia, is $1.15, and this rate is, of course, much increased for the smaller and lighter packages. The motor truck's rate is therefore lower than the express rate, and it gives an equally prompt delivery.

The cost per mile of opearting trucks on the New York-Philadelphia run is much lower than for the trucks whose expenses are considered in Tables II to IV, because the average daily mileage is 100 miles instead of 50 miles.

There are, however, two items of expense on the New York-Philadelphia service which should be added to those already ascertained. The first of these is the driver's expense account. The driver must be provided with meals and lodging when away from home. One of the New York-Philadelphia companies allows its drivers $2 per day for expenses, or $480 per year for a year of 240 days. The second of these is the expense of carrying on the business, especially the handling of express parcels. This is much higher than the $696 per truck allowed under the head "Supervision" in Table IV. There is the rental of warehouses at each end to be provided for, and the wages of billing clerks, loaders, and collectors. In other words, the motor-trucking concern carrying on an express business has to have quite a terminal organization and terminal expenses of its own.

The amount of these terminal expenses will obviously vary greatly according to whether a concern is hauling chiefly freight in sizable consignments or small parcels.

For a tentative estimate of the annual overhead expenses of a five-ton truck in the New York-Philadelphia business we may add to the $5556 in Table IV the following items:

Depreciation (additional)	$300
Repairs (additional)	200
Driver's expense allowance	480
Conduct of business (additional)	400
	$1,780

We thus have a total of $7336 as the annual overhead charges or for a year of 240 days, $30.44 per day.

In ordinary operation the trucks make one trip over the road daily and return the next day. For this 200-mile round trip the total cost will be

Overhead charges, 2 days at $30.44	$60.88
Direct charges for gasoline, tires and lubrication, 200 miles at 14c.	28.00
	$88.88

Average cost per mile $88.88 ÷ 200 = 44.4 cents.

If a motor truck could always run fully loaded, both ways, the cost per ton-mile of transporting freight by it on the basis of the above figures would be only

44.4c. ÷ 5 = 8.88c. per ton-mile. But no transportation business ever has such ideal conditions. The motor trucks, on this particular run, on account of the large volume of business available, can generally get a fair-sized load one way; and at least a partial load on the return trip. If a truck carries five tons one way and one ton on the return trip, it will accomplish 600 ton-miles of transportation on the two days' round trip and the cost per ton-mile would be, according to the above estimates, of $88.88 ÷ 600 = 14.81 cents.

It will be obvious from the above figures, as from the earlier tables, that the success or failure of a motor-trucking concern depends chiefly on its ability to keep its trucks moving with full loads.

Interurban Motor Truck Traffic in Ohio

Figures for the cost of motor-truck operation on interurban routes in Ohio which were published in *Engineering News-Record* of Apr. 10, 1919, p. 717, are noteworthy because they show results with trucks of smaller capacity than those above considered, and also because of the inclusion of items for driver's expenses and for helpers on the run. The figures cover the operation of 12 trucks of 3½ tons capacity which have been operated for a year between Cleveland and Akron, and Cleveland and Youngstown. The Cleveland-Akron run was a round trip of 100 miles, including movement in the city to pick up and deliver goods.

In this service the cost of truck operation was found to be as follows, using the same form as in Table IV:

ANNUAL OVERHEAD EXPENSES

Driver's wages	$1500
Driver's expense account	300
Part time of helper	100
Depreciation (20% on $5000)	1200
Interest (6% on depreciated value)	180
Insurance	450
Complete overhaul	600
Overhead (including supervision, license, taxes, warehouse rental and all help other than drivers, helpers and repair men	1600
	$6438

DIRECT EXPENSES PER MILE RUN

Gasoline, 3.2 miles per gallon at 25c	7.81c.
Lubricants	0.94c.
Tires	5.77c.
Total	14.52c.

The trucks made an average of 16,500 miles per year, so the total of overhead and direct expenses was 53.52c. per mile. The average load was 4.25 tons from Cleveland to Akron and 2.15 tons on the return trip, or a total of 320 ton-miles for the round trip of 100 miles, or an average cost of 16.7c. per ton-mile.

It will be noted that while these trucks were of a normal capacity of 3½ tons, they were regularly overloaded, carrying over 20% in excess of their rating, on the average. The expense of operation was not materially less than for five-ton trucks in any item except interest and depreciation, which were less on account of the smaller first cost. This result agrees with the experience of some of the companies which have operated 2½-ton trucks on the New York-Philadelphia run, and find a reduction of only a couple of dollars or so per day below the cost of operating five-ton trucks. The cost per ton-mile for hauling with the small-capacity truck is therefore much greater. This would be more apparent in the above figures for the 3½-ton trucks in the Cleveland-Akron service except for the habitual overloading.

The motor-trucking concerns on this Ohio route are in a condition similar to that of those operating between New York and Philadelphia. Goods have been carried at very low rates, in many cases less than cost, because the truck operators did not know what their costs were. This fact, with the competition of the trucking concerns which run only an occasional trip, has made the business generally unprofitable; and it is stated that of some twenty trucking companies which have carried freight between Cleveland and Akron, there are only two still in business which have lasted over a year.

Cost of Operating Fifth Avenue Omnibuses

Some very low figures for the cost of motor-vehicle operation are given in the official report of the New York Omnibus Co., which operates a fleet of over 200 motor omnibuses in New York City. These vehicles weigh five tons and have seating accommodations for 44 passengers. The average load carried is probably not over half a ton, but the frequent stopping and starting and the operation in crowded traffic are of course unfavorable to economy in fuel and repairs. The smooth asphalt pavement and very easy grades over which the buses run are, on the other hand, far more favorable than the average roads used by motor trucks, and the omnibuses average 72 miles per day as compared with the 50 miles per day assumed in Tables I to IV. Lost time is also, of course, very small.

The total operating expenses of the Fifth Ave. omnibuses in 1916, according to the company's official report to the New York Public Service Commission, were 18.22c. per bus-mile or $13.13 per day (excluding wages of conductors). The cost per mile for tires was only 1.11c. and for fuel, 2.18c. The drivers were paid only 30c. per hour.

These omnibuses may be considered as about equivalent to a two-ton motor truck, run fully loaded (part of the weight of the double-deck body being considered as load). On this assumption the operating cost of these vehicles would be 9.11c. per ton-mile. The reported operating cost omits interest on the investment and profit, but is supposed to include depreciation.

It will be readily understood that the operation of such a large fleet of vehicles over regular routes makes possible many operating economies that would be out of the question on a country line where only five or six vehicles are used, and where conditions of road and load are much less favorable.

Motor Trucks Handling Excavated Material on a Short Haul

In the construction of the Army base storage warehouses in Brooklyn, N. Y., in 1918, 185,350 cu.yd. of excavated material was hauled by motor trucks from the site to a dump 3.2 miles away, and careful records were kept of the hauling cost separate from the loading cost. The trucks worked 10 hours per day and averaged 57.6 miles per day, including of course the return trip empty. The average load hauled was 4.35 tons. The haul was over paved streets. The trucks averaged nine round trips per shift. The cost of haulage, including payroll, supplies, a commission of 6% on the cost of supplies and plant rental, was 23½c. per ton-mile.

There are a great number of places throughout the country where hauling is being done with motor trucks at prices that appear very low compared with the figures of cost which have been given above. Careful investigation generally shows that those who are carrying

freight at very low figures are doing so because they do not understand the necessity of including interest and depreciation in their costs if they would escape bankruptcy.

What is perhaps a typical example of much of the motor-truck competition now going on is furnished by motor-truck freighting between two towns in Montana, Whitefish and Kalispell. These towns are 18 miles apart by highway, while the distance by rail is 25 miles and the rail route is not direct. The highway has been improved for the whole distance with gravel or macadam and the grades are generally practically level. The railway rates from Kalispell to Whitefish for l.c.l. shipments are: Per 100 lb.; first-class, 27½c.; second-class, 24c.; third-class, 19c.; fourth-class, 16½ cents.

A motor-truck line is run between the two towns by a man who also operates a motor omnibus over the same route and runs an automobile livery business. He operates two two-ton trucks for freight-handling and carries freight from Kalispell to Whitefish for 20c. per 100 lb. for ordinary freight and 25c. per 100 lb. for perishable freight. At this rate he gets three-quarters of the less-than-carload shipments, while the railway handles the balance and the carload business.

His two trucks average one round trip daily each week-day for 10 months in the year, and generally get full loads one way, but no return load worth mentioning. At the 20c. per 100 lb. rate, the charge per ton for the 18-mile haul is $4, or 22c. per ton-mile. When carrying a full load, each motor truck will earn $8 per day. Gasoline costs 29c. per gallon, or $1.50 per round trip. This leaves only $6.50 to cover cost of tires and lubrication, wages of driver, interest, depreciation, repairs and all the other overhead expenses enumerated in the preceding tables.

The owner of the truck says he "is making a good comfortable living out of the business." He is doubtless sincere in the belief, but he is typical of many motor-truck operators who, like the early drivers of the "jitney" cars, are using up their capital without knowing it.

Handling Farm Products by Motor Truck

A bulletin on "Motor Transportation for Rural Districts" was issued by the Bureau of Markets of the United States Department of Agriculture, Jan. 29, 1919. It records the results of investigations of 60 motor-truck express routes in various parts of the country. Very few truck operators were found who had any accurate records of the cost of conducting their business. The Bulletin says:

> It is a regrettable fact that there are practically no rural truck operators whose general plans are worth study by less experienced operators. Practically nowhere have rates for truck transport been fixed by adding a percentage for profit to the cost of service. Cost of operation is not well understood by most operators and very few have any authoritative information in this connection. The bureau found numerous cases where truck operators who thought they were making a profit were, as a matter of fact, gradually using up their original investment for current expenses.

In the concluding portion of the bulletin the limiting factors to the development of motor trucking in rural districts are summarized as follows:

> The chief factor limiting development in the field of rural motor hauling is the cost of operation as compared with that of railroads, electric lines and boat lines. Careful attention to effecting economies may offset this limiting feature to some extent, but in the main the operator cannot change his costs of operation to a very marked degree. This means that he must cater to a class of business which will pay a small additional premium for a speedier, more dependable or more complete service.

Motor-Truck Costs Under Country Conditions

The figures in Tables II. to IV. above represent the costs prevailing in or near the large cities. It is important to consider what changes may be expected in these figures in operating motor trucks in a country district on such a line as is here considered.

Driver's Wages—Recent action by the labor organizations ordering an increase of wages and reduction of hours for truck drivers will raise the pay of drivers considerably above the $1500 given in Table III. In country districts, however, where living is cheap and labor unions are less powerful, drivers could probably be hired for regular runs, on an annual salary, for not over $1200 per year.

Interest and Depreciation—The charges for interest and depreciation are based on a five-ton truck costing $6000 new, or $1200 per ton capacity. This price is higher than the average cost of trucks, but is that charged for a make of truck which has a high reputation for reliability and freedom from breakdowns.

One of the striking features of Table III is the revelation it makes that of the cost of hauling freight by motor trucks about three-fourths is overhead charges which go on just the same whether the truck is working or idle. To save $1000 in the first cost of a truck, therefore, would be very poor economy if the saving in cost means that material and workmanship are of a sort that will increase the percentage of breakdowns and the time the truck has to stand idle for repairs.

On the other hand, present prices for trucks are based on war-time costs of labor and material. There is sharp competition in motor-truck manufacture, and a material reduction in prices will eventually result.

Garage—The figure for garage rental of $300 per year per car is doubtless fair for large cities, but it is too high for country conditions where both land and labor are comparatively cheap. Half the amount would probably be better representative of conditions there.

Repairs and Supplies—The figures for repairs and supplies plus annual overhauling amounting to $900 per year are probably high, judging by the figures given in Table III, although several of those who report approve them as they stand. Under country conditions of lower labor cost, and with the prospect of reduced prices for supplies in the near future, probably $600 per year would be a fair estimate.

License—The license fee of $60 per year is doubtless the actual amount; but a general heavy increase in motor-truck license rates must be expected. Illinois is issuing $50,000,000 of bonds for road construction on the assumption that the interest and sinking-fund charge on the issue will be paid from motor-license receipts. The motor truck, because of the heavy burden it has placed on road departments, is sure to be assessed heavily for its license in the near future.

Superintendence—The item of "supervision," amounting to about $700 per year per truck, covers the whole cost of carrying on the business, office rent, salaries and

the entire office expenses. For operating, say five trucks to carry 25,000 tons per year, this would mean a total of $3500 to carry on the business. It would seem difficult to do it for any less.

Direct Costs—The bill for tires should be reduced, as tire prices are likely to fall after war conditions cease, and in operating over regular routes the tires often do better than the guarantee. The lubricant estimate is probably high in Table II. For future price conditions and in country operation, a total cost for tires and lubrication of 5c. per mile is reasonable.

The future cost of motor fuel is a subject on which much might be written. There is no doubt that the consumption of liquid fuel in internal combustion engines is increasing much more rapidly than the supply. The cessation of the war relieves the situation for a time, but higher prices for gasoline in the future appear inevitable. Some help may be afforded by the development of a satisfactory kerosene carburetor; yet this will not last long, as the consumption of kerosene also would then soon increase and overtake the demand. On the whole, the fuel item may well stand as in Table II.

Omitted Items—In the preceding tables two notable omissions are, first, taxes, which the motor-truck owner cannot expect to escape, and second, profit, which the truck operator must have, at least in sufficient amount to cover the inevitable risks of the business.

Lost Time—All the items of expense above considered are computable within fairly close limits. The variations noted make no very great difference in the total of operating expenses. We come now, however, to an item whose variation does very greatly alter the ton-mile cost of motor-truck transport—the item of lost time. How many days in the year can a motor truck operate? What average mileage will it make on these days? What average load will it be able to obtain? On the answers to these questions usually turns the success or failure of a motor-truck business.

Deducting Sundays and holidays, there are about 300 business days in the year. In Table II it is assumed that 60 of these days, or a little over two months, will be idle time because of repairs, the annual overhaul, roads impassable on account of winter snows or ice or stormy weather, or lack of business. This is surely a very moderate allowance. Indeed, it is too low for average winter conditions in the northern part of the United States.

Peak Loads in Handling Farm Products

The conditions of operation shown in Table II. represent the experience of a large operator of motor trucks having a fleet of over 75 vehicles and doing hauling by contract in various parts of the country. The conditions which we are here discussing are those of motor trucks carrying traffic on a branch line from a railway station to an outlying town, and everything depends on the character of the traffic to be handled. If coal from a mine is to be hauled to the railway, then something like a uniform traffic the year round may be expected. On the other hand, suppose the line penetrates a grain-growing region where wheat or corn or barley is shipped to market during three or four months following harvest, and there is only a light business during the rest of the year. In such a case there must be trucks enough to carry "the peak of the load," and several of them may have to stand idle a good part of the year.

The figures given in Table IV, are based on an average of 240 operating days per year and 50 miles per day. Under the branch-line conditions which we are discussing, the average days of operation per year, on account of lack of business in the slack season, might fall to say 200. On a line only 10 miles long, the daily mileage, even in the rush season, allowing for delays at each end, would hardly exceed 50 miles.

The figures given in Table IV, when revised to apply to the conditions on a country branch line as indicated above, and with the lower prices for labor and equipment that may be fairly expected in the future, would be as follows:

TABLE V. ESTIMATED OVERHEAD CHARGES PER YEAR FOR A 5-TON GASOLINE MOTOR TRUCK OPERATED ON A COUNTRY BRANCH LINE UNDER NORMAL PRICE CONDITIONS AND AVERAGING 50 MILES PER DAY FOR 200 DAYS PER YEAR

Driver's wages	$1200
Depreciation (20% on $5000 investment)	1000
Interest (6% on $5,000 investment)	300
Insurance	450
Garage	150
Maintenance and annual overhaul	600
License fee	100
Body upkeep	60
Supervision	696
Taxes (2% on $5,000)	100
Profit (10% on $5,000)	500
Total per annum	$5,156
Total per day for 200 days	$25 78
Total per mile for 50 miles per day	$1 56
Direct Charges Per Mile	
Tires and lubricant	5c
Gasoline	7c
	12c
Total of overhead and direct charges per day	$31 78
Total of overhead and direct charges per mile	63 56
Cost per ton-mile for full loads one way and half load returning	16 90

From this table it is again evident how much more the ton-mile cost is influenced by the annual mileage made and the tonnage carried than it is by changes in the figures for operating expenses, even when the changes are of considerable amount.

(B) *COST OF OPERATING LIGHT-TRAFFIC RAILWAYS*

We next desire to know the ton-mile cost of hauling freight over the light-traffic railway whose construction cost was estimated above. To make the figures directly comparable with those assumed above for the motor truck, they should include maintenance and depreciation charges on the rolling stock, but should exclude those on the roadway itself, since these have already been separately estimated.

There are no railway statistics from which such figures can be directly obtained. To give a basis for an estimate, Table VI has been compiled from the Interstate Commerce Commission statistics for 1916. It gives figures of operating cost for nine railway companies of Class II (those having gross earnings between $100,000 and $1,000,000 per annum) which have a traffic density less than 20,000 ton-miles per annum per mile of road.

Omitting two of the companies named in Table VI which carried less than 6000 ton-miles of freight per mile of road, the average freight charges on the other six roads varied from 2.91c. to 5.30c. per ton-mile. This freight rate was generally high enough to pay the operating expenses (which includes the cost of track maintenance), but left very little balance for a return on the investment. There should be deducted from these ton-mile charges, therefore, a sufficient amount to cover the expenditure on track maintenance, and there should be added a sufficient amount to cover interest and depre-

ciation on the rolling stock used. On any light-traffic railway such as we are considering, maintenance of way will cost much more than interest, maintenance and repair of rolling stock.

Reference to Table VI shows that the ton-mile costs are closely influenced by the size of the train hauled. The Ouachita & Northwestern R.R. hauled 120 tons of freight per train, charged 2.91c. per ton-mile and earned $3.38 per freight-train-mile. Its entire expense for conducting transportation and maintaining its rolling stock was $1.47 per freight-train-mile. Hence, after adding to this last-named figure a reasonable amount to cover interest and depreciation on the rollong-stock equipment, it is clear that its average freight rate of 2.91c. per ton-mile was probably nearly double the operating cost, omitting the roadway expenses.

The Ohio River & Northwestern Ry. had an average freight-train load of only 23.68 tons and earned $1.03 per freight-train-mile from its ton-mile charge of 5.03c. Its expenses for conducting transportation and maintaining rolling stock were 48c. per mile run by all trains, passenger as well as freight, indicating a cost of perhaps 3c. per ton-mile.

The investigation might be continued at much greater length, but the figures already quoted are sufficient, probably, to show, first, how greatly the operating cost per ton-mile varies with the size of trainload, and, second, how great is the advantage of the railway over the motor truck in being able to handle its traffic in large units.

(C) *COST OF HAULING OVER EARTH ROADS*

As has been pointed out, the drawback of the earth road as a highway is not merely the high cost of transportation over it, but the blockade of transportation over it by mud for a considerable part of the year. This blockade is a much more serious matter for motor trucks than for horses and wagons, on account of the very high overhead charges shown above.

Before the war a common price in many parts of the country for the hire of a team of horses and driver was $5 per day. Such a team might haul a two-ton load over a good earth road in good weather for 10 miles and return with the empty wagon for a day's work. This gave a total of 20 ton-miles per day at a cost of $5, or 25c. per ton-mile. This figure was reduced in some cases by the use of three or four horses, which on a gravel road or on an earth road in a dry climate would enable the load to be increased to three or four tons.

Under the conditions of a dozen years or more ago, hauling freight by highway was done at the lowest ton-mile cost, not over the good roads of the East, but on some of the long hauls over very primitive roads in the Far West. Here freight hauling was an important business. Long strings of 6 to 10 horses or mules were attached to a heavy, broad-tired wagon, behind which were often attached one or more trail wagons. At that time horses and mules were raised at very small cost on the great Western stock ranches. As two men could manage a freighting outfit carrying 6 to 8 tons, the ton-mile cost was brought down to a low figure.

The war ended this condition. Prices of horses, mules, harness and feed were doubled in a short time, and the cost of labor was likewise doubled. It will be a long time before these prices sink to their former level and it may well be doubted whether the former conditions can ever be reproduced.

GOVERNMENT STATISTICS ON COST OF HAULING FARM PRODUCE

In 1906 the Department of Agriculture collected information from its county crop correspondents in all parts of the United States concerning the cost of hauling farm produce from the farms to shipping points over common roads. Recently that inquiry has been repeated, and the results of both inquiries were published in the Department's "Monthly Crop Report" for

TABLE VI. RAILWAY COMPANIES HAVING FREIGHT TRAFFIC LESS THAN 20,000 TON-MILES PER ANNUM PER MILE OF LINE IN THE YEAR ENDING JUNE 30, 1916

	Central New York and Southern (N. Y.)	Ohio River and Western (Ohio)	Tide-water and Western (Virginia)	Wadley Valley (Georgia)	Electric Short Line (Minnesota)	Gilmore and Pitts-burgh (Montana)	Ouachita and North-western (Louisiana)	San Joaquin and Eastern (California)	Tanana Valley (Alaska
Name of Company									
Length of road, miles	38	112	93	89	59	120	66	56	45
Locomotives	4	11	6	5	4	4	9	5	4
Freight cars	19	204	138		193	242	213	1	24
Passenger cars	9	20	10	9	25	15		5	5
Character and Density of Traffic									
Ton-miles per mile of road	18,348	16,748	19,833	16,349	17,039	18,289	12,749	5,311	5,537
Passenger-miles per mile of road	66,246	47,324	3,697	11,465	92,153	5,126		3,600	11,450
Freight and mixed train miles per mile of road	889	707	688	637	469	351	1,057	664	763
Passenger train-miles per mile of road	3,208	1,454	30	914	3,274				229
Tons per freight train	20	23.68	28.85	25.68	36.33	52.03	120.63	7.99	7.25
Tons per loaded freight car	6.46	5.91	9.02	8.79	12.29	17.26	8.87	8.40	7.67
Passengers per passenger car	15.47	17.27	4.89	4.20	25.06	8.57		3.49	11.95
Earnings per ton-mile, cents	4.09	5.03	3.31	4.23	4.57	5.30	2.91	10.45	28.32
Earnings per passenger-mile, cents	2.28	2.01	3.37	2.78	1.85	4.65		6.29	7.21
Earnings per frt. train-mile	$0.84	$1.03	$0.95	$1.06	$1.33	$2.54	$3.38	$0.67	$2.05
Earnings per passenger train-mile	$0.55	$0.84	$0.28	$0.25	$0.53	$0.84		$0.41	$1.02
Earnings per mile of road	$2,839	$1,985	$882	$1,086	$2,509	$1,178	$3,634	$723	$2,636
Expenses per mile of road	$2,297	$1,985	$817	$1,153	$2,173	$985	$3,302	$1,650	$2,479
Distribution of Operating Expenses									
Maintenance of way and structures	$12,370	$85,149	$27,305	$27,498	$17,116	$32,208	$102,077	$35,827	$36,234
Maintenance of equipment	12,341	42,559	9,849	17,227	11,210	35,461	34,756	17,359	10,526
Conducting transportation	46,794	74,840	27,651	46,524	63,518	41,181	67,827	25,310	49,056
General Financial Results									
Investment in road and equipment	$1,104,114	$1,383,828	$638,496	$1,468,528	$1,772,473	$5,405,340	$548,176	$1,197,158	$2,118,790
Investment per mile	29,060	12,300	6,870	16,500	30,000	45,040	8,300	21,300	47,080
Gross earnings	106,923	221,780	81,656	96,371	115,777	140,955	238,197	40,433	117,809
Operating expenses	86,511	221,786	75,568	102,363	100,299	117,787	216,419	92,266	110,799
Net earnings	20,412	—6	6,088	—5,992	15,483	23,168	21,778	—51,833	7,010
Per Cent. Operating Expenses to Gross Earnings	80.91	100.00	92.54	106.22	86.63	83.56	90.86	228.19	94.05
Paid interest on bonds	$50,000	$30,915	$12,000	$40,000		$240,000		$50,000	$34,500
Paid dividends									

October, 1918. The averages for the entire United States are briefly as follows:

	Horses and Wagons		Motor Trucks
	1906	1918	1918
Distance hauled, miles	9.7	9.0	11.3
Round trips per day	1.2	1.2	3.4
Bushels carried per load:			
Corn	39	39	58
Wheat	55	56	84
Cost of hauling per ton-mile:			
Corn	19c.	33c.	15c.
Wheat	19c.	30c.	15c.

In presenting these figures, the author of the report, Frank Andrews, of the Bureau of Crop Estimates, says that while most of the hauling from farms is done by the farmers themselves, the estimated costs reported are based largely upon the usual charges in the various counties for hiring a team and wagon or motor truck by the day.

These figure show the great advance that has taken place in the cost of hauling by horses since the war. The figures of cost reported are subject, however, to a very large percentage of error. The table of costs of haulage in different sections of the United States in the "Crop Report" bears internal evidence that the ideas of the various correspondents and their informants as to what constituted the cost of transport varied widely. Costs per ton-mile for wagon haulage reported in 1906 varied from 16 to 28c., and in 1918 from 22 to 52c. For motor trucks, the reported costs per ton-mile vary from 36c. in the Rocky Mountain region to 9c. in the North Central States.

In studying these figures it should be borne in mind further that the motor trucks used for hauling farm produce are generally of small capacity, one or two tons only, and that their use for hauling farm produce can cover only a small part of the year. From the analysis of motor-truck operating costs which has preceded, it appears altogether probable that the figures for haulage cost reported by the Department of Agriculture's correspondents, in many cases, at least, include only the direct cost and omit such important factors as interest, depreciation and other overhead expenses.

IV. Road Costs and Hauling Costs Combined

On the foundation laid by the preceding discussion, a comparison may now be made of the cost of highway traffic and railway traffic, by adding to the figures per ton-mile for the use of the road, given in Table I, suitable figures for the cost of hauling traffic over the road.

It will be clear from the preceding discussion, also, that the choice of any particular figure to set down must be made arbitrarily and represents merely an assumption to fit a hypothetical set of local conditions. What has been determined is that the cost of moving traffic by the three methods considered varies between wide limits. Motor-truck hauling costs under the country branch-line conditions here assumed might range from 12c. to 25c. or more per ton-mile; railway operating costs from 1½c. to 5c. or more per ton-mile; haulage with horses and wagons from 20c. to 40c. or more per ton-mile. In Table VII, in which the road costs and hauling costs are combined, medium values are taken in each case.

Doubtless, many engineers will be surprised that the cost per ton-mile for hauling by motor trucks is so much greater than the ton-mile cost on a light-traffic railway. Yet it needs only a direct comparison of the conditions of operation to see how great is the advantage of the rail line in moving freight. The railway locomotive, even on a light-traffic line, hauls 20 to 100 tons or more of paying freight, as compared with five tons hauled by the motor truck. The railway locomotive develops its power from coal costing $1 to $3 per ton,

TABLE VII. COMPARATIVE COST OF HAULING 25,000 TONS OF FREIGHT PER ANNUM OVER A LINE 10 MILES LONG BY THREE DIFFERENT METHODS

Kind of Road	Cost per Ton per Mile for — Use of Road, Cents	Hauling, Cents	Total, Cents	Total Cost per Ton for 10-Mile Haul
Earth road	1.24	35	36.24	$3.62
Motor-truck road	5.09	16	21.09	2.11
Railway	5.24	3	8.24	.82

while the motor truck burns gasoline at 25c. or more per gallon. The railway car has chilled cast-iron wheels rolling on steel rails. The wheels and rails cost perhaps $30 per ton, and their wear is very small. The motor truck rolls on rubber tires, whose cost per ton-mile of traffic moved may be nearly as great as the entire cost per ton-mile of operating the light-traffic railway.

The motor truck in five-ton units costs about $1200 per ton of carrying capacity and has a life of only five or six years. A railway freight-car of moderate capacity, such as would be used on a light-traffic road, costs perhaps $25 per ton of carrying capacity. A light locomotive would cost as much more per ton of hauling capacity or a total for the railway rolling stock of about one-twenty-fifth as much per ton carried as a motor truck costs. Cars and locomotives, which roll on rails, have a very long life, at least 20 to 25 years on the average. The motor truck or any vehicle which travels over highways, even when the latter are well paved, is subjected to shocks and wear and tear that limit its useful life to five or six years.

Reference has been made in the preceding discussion to the difficulty a motor-truck line experiences in handling peak loads economically. The contrast in the cost per ton capacity of the railway freight car over the motor truck makes it evident why the railway can handle its peak loads at a small fraction of the cost of a motor-truck line. In Table IV the overhead expense of a five-ton motor truck was shown to be at the rate of about $5500 per annum, when the truck is in active use. When such a truck is out of commission for a long time because of lack of business these overhead expenses would be reduced to perhaps $2000 per annum, or $400 per ton of capacity. This figure is easily fifty times the cost to a railway of its idle freight cars per ton of capacity.

The railway has a special advantage in handling peak-load conditions on a branch line if the track of the branch will stand the operation over it of standard freight cars. Not only is transfer of freight at the junction with the main line saved, but cars of foreign roads are brought in to move the crops or other seasonal business, and are taken elsewhere when the rush season is over.

V. Conditions Which Favor Motor-Truck Operation

The preceding comparison of the highway and the railway has been made on the assumption that the two lines would be built on substantially the same route

between terminals. It very often happens, however, that motor trucks compete with the railway under conditions which handicap the rail route either in cost of construction or in cost of operation or both.

Steep Grades—The motor truck can in case of necessity climb grades as steep as 20%, while 10% is about the limit of what the railway can negotiate and grades above 5 to 6% require either operation of the railway with motor cars or else such expedients as very heavy geared locomotives and a small load hauled in proportion to the weight.

It often happens that a highway for motor trucks can be built between two terminals which will be one-half or one-third as long as a railway line between the two points. This of course heavily handicaps the railway in the competition.

Limited Right-of-Way—If a branch-line railway is built it must generally be located on its own right-of-way, and there must be a public highway besides to reach the same point. There are many locations where the right-of-way for the railway line will involve difficulty and large expense. It is a very great advantage of the motor truck that it operates on a highway which is usable by other traffic as well.

Right-of-way difficulties for railway construction have multiplied manyfold since the days of active railway building thirty years ago. The mere fact that the motor trucks now available to move traffic over an improved road helps to satisfy the public demand for cheaper transportation and lessen the possibility of success in obtaining at any reasonable figure the right-of-way for a branch railway line.

Handling Local Business—In the comparison of cost above it was assumed, for the sake of simplifying the computation, that the traffic was all moved from terminal to terminal. In nearly all cases, however, the traffic on a country branch line should be picked up and delivered all along the route. The motor truck running on the highway has a great advantage in serving the population along the line of the road over the railway operating on its own right-of-way.

Again, the motor truck's ability to take its load from origin through to destination, while less important than at the city terminal, has a value in the country as well. On a certain part of the traffic handled by the railway there must be added a transfer charge at one or both ends of the line before the cost of rail haul can be directly compared with the cost of the motor-truck haul.

Short Railway Spurs No Longer Practicable—It is evident too, that the coming of the motor truck has ended the construction of very short branch or spur-line railways, except when these are designed to handle special traffic such as the output of a mine or an industrial plant, or a timber tract. Of course, where a branch can interchange cars with the main line and avoid transference of freight at the junction point, it can often save materially by delivering freight nearer to its final destination and shortening the final haul over the highway.

The cost of operating very short branch-line railways, however, is disproportionately high, and it is so difficult to get a rate for the short distance that will compensate for the cost that there is no incentive for the building of such roads.

When the railway era began, the cost of railway freight transportation was several times what it is today. Can a like reduction be expected in the evolution of the highway and the motor truck? Undoubtedly, motor truck costs will be reduced; but the inherent limitations under which the truck operates forbid hope of any such great reduction as has occurred on the railway. Passenger fares by rail, it may be noted, are not greatly changed from those in force seventy-five years ago. The cost of freight haulage has been reduced chiefly by handling traffic in larger units—large cars and long trains. No change of such great extent is possible with the motor truck operating on the public highway. There are, however, certain economies that may be made by hauling trailer wagons behind the motor trucks and thereby increasing the tonnage hauled in a single outfit.

Examples of the Use of Trailers

The Highways Motor Transport Co., of Cleveland, Ohio, has been operating for a year past a fleet of Troy trailer wagons of three tons capacity. These are hauled behind Packard trucks and operate from Cleveland to points as far east as Conneaut, 70 miles, and west to Toledo, 120 miles. It is stated that these trailers are operated at an average cost of 8.3c., per mile, and have an overhead charge of $3.50 per day for interest and depreciation on the investment, insurance, garage expense and a helper at $3 per day. Assuming an average daily mileage of 50 miles per day, these overhead charges amount to 13c. per mile. Adding the direct expense of 8.3c. per mile, we have a total of 21.3c., or 7.1c. per mile per ton carried.

Another trucking concern, the Liberty Highway Co., has for some time operated trains consisting of a four-wheel drive five-ton motor truck hauling two Troy five-ton trailer wagons between Toledo and Detroit, a distance of 70 miles. The trip is made in 7½ to 9 hours and two trips are made in three days. Detailed figures of cost are not obtainable; but from the preceding review of the cost of motor-truck operation it will be evident that the much larger tonnage handled in one unit will cut down the cost per ton-mile very greatly. The first cost of the trailer wagon per ton of capacity is less than half the cost of the motor truck, and its depreciation and repairs are very much less. Of course, there is an increase in the operating cost per mile for fuel and for repairs, when a truck is used as a tractor; a helper for the driver is required, and the speed is materially reduced.

From such figures as are available, it appears to be a fair estimate that where road conditions make possible the hauling of ten tons of freight on trailers behind a five-ton truck, and the business is sufficient to obtain fair loads, the cost of hauling per ton-mile should be cut in half compared with the cost of carrying with the truck alone.

There is no doubt that the use of trailers is bound to increase rapidly. A dozen enterprising manufacturers are already building trailer wagons for use behind motor trucks. Even for short hauls in and around cities the use of trailers is rapidly increasing; and the saving by their use is much greater where they are used for longer hauls and are operated between terminals over regular routes.

There is another most important possibility in the operation of trailers, and that is their use to distribute

and collect freight without rehandling at the end of the run. As already noted, it does not pay to use a five-ton truck to collect small shipments, and roads radiating from the terminal would often be too weak to carry such a truck. Trailer wagons of one to three tons capacity, however, could be hauled by horses or light motor-trucks to farms or stores or mills to be loaded or discharged, and then returned to the terminal to be made up into trains to be hauled over the main road.

There is without doubt more or less of a tendency to discourage the use of trailers by imposing legal restrictions. These restrictions are justified where steel-tired vehicles are hauled behind motor trucks over hard roads. The injury to the road done by steel-tired wheels hauled at motor-truck speeds justifies legal restrictions on the use of such trailers. The wear and tear on the vehicle so operated is pretty certain to limit its use closely, even in the absence of official road ordinances.

The use of trailer wagons with rubber-tired wheels behind motor trucks, however, appears favorable to the highways rather than otherwise. Where trailers are hauled, some of the temptation to overload the truck itself is removed. Still more important, probably, is the reduction of speed where trailers are hauled.

There is every reason to believe that overspeeding of heavy trucks is as important a cause of injury to improved roads as overloading. The impact of a motor truck, carrying nine tons or more on the rear axle and traveling at 10 to 20 miles an hour, as its wheels roll over the unavoidable imperfections in the paved surface, is evident to the senses of anyone standing beside the road as the truck passes.

Without doubt, the speed of motor trucks should be strictly limited by automatically locked governors which would not only shut off power but apply brakes when speed limits are exceeded, to prevent overspeeding down grades. Truck drivers have been prolific, however, in finding ways to beat speed governors; and where a truck's speed is held down by hauling trailers, the road is saved from a certain amount of impact.

Economic Capacity of Motor Trucks

The question will inevitably be raised whether the cost of motor trucking might not be reduced by using larger trucks of capacity, say 10 tons, and building the road strong enough to carry them. From all information available, the cost of roads capable of enduring such a heavy loading would be out of all proportion to the saving made.

The five-ton truck fully loaded imposes a load of some 18,000 lb. on the rear wheels, and requires a tire some 10 in. wide on these wheels. To double this load would require doubling the width of face of the tire; but such very broad tires do not distribute the stress equally. The tires, the trucks themselves and the roadway are all sure to suffer. The 10-ton truck has a field, doubtless, on paved city streets; but for country roads the five-ton truck appears to be fully as large a vehicle as practical road-building conditions warrant, especially as it is not uncommon to see such trucks actually carrying a load of six to seven tons.

There will not be lacking engineers, doubtless, who will argue that the five-ton truck is too heavy and that a three-ton truck, which would permit a cheaper roadway that would have a longer life with less cost for maintenance, would be, in the long run, more economical. Experience in the operation of heavy motor trucks is still too limited to permit a final answer to this question. The most that can be said is that the opinion of engineers who have had the best opportunity to observe the behavior of roads under heavy motor-truck traffic is that roads can be built within practicable limits of cost which will give satisfactory service under the five-ton truck.

It may be noted here, also, that the answer to this question will be influenced by climatic conditions. In the mild and arid climate of California, for example, where heaving from frost is unknown and where drainage is comparatively simple, the road engineers do not worry over 10-ton sugar-beet trucks passing over the roads. In a humid climate, where frost penetrates the ground 3 to 4 ft. in an ordinary winter, the road engineer may be excused for an unfriendly feeling toward heavy motor trucks in general.

VI. Making Light-Traffic Railways Pay

The importance of the light traffic railway as a part of the whole transportation machine is demonstrated by the preceding discussion. What can be done to put these lines on a better basis?

The first and most obvious thing is to permit them to charge, so far as the traffic will bear it, rates high enough to cover their operating expenses and fixed charges. That railway rates should be sufficient to cover at least the cost of service is now accepted by everyone. In conformity with this principle, the light-traffic lines should be made to pay their way. The practice of operating these lines at a loss and making up the deficit from the profits earned on the main line is economically unsound and effects an unjust distribution of the transportation tax.

The other way to make the light-traffic railways pay is by operating them at lower cost, and, in the case of newly built roads, constructing them at low cost so as to keep down fixed charges.

Few realize, probably, that the railway of today is far inferior to the railway of half a century ago for handling light traffic economically. American engineers, faced with the necessity of handling heavy, long-distance traffic at low cost, have led the world in increasing the size and capacity of railway cars and locomotives. The result has been as injurious to the light-traffic lines as it has been beneficial to the roads of heavy traffic.

A great deal has been written concerning the enormous saving in transportation cost through the interchange of freight cars, by which a freight shipment travels from origin to destination over many different lines of railway without breaking bulk. But on branch lines of light traffic this means at the present day that track and bridges must be capable of carrying cars of 100,000-lb. capacity. Indeed, on the heavy-traffic lines in the East it is recognized that the coming freight car is the 200,000-lb. car. It is already a very important problem on many branch roads whether large amounts of money should be spent in strengthening track and bridges or whether an embargo must be laid on cars of high capacity. On branch lines of considerable length which handle only light traffic there can be little doubt as to the answer. Notwithstanding the protests of individual shippers and consignees, such as

coal merchants, it will often be a more economical proposition to transfer the loads of exceptionally heavy cars than to build and maintain track and structures capable of carrying them safely.

On the lines of lightest traffic, this principle may be carried further still and special, light rolling stock may be used. Of course this applies rather to lines hereafter constructed than to present lines, since there are hardly any standard-gage roads now in operation which have not been built to carry ordinary standard-gage rolling stock.

It will require courage to defend this light-rolling-stock proposition, because in the public mind the idea has become firmly fixed that big cars and big locomotives are synonymous with economical transportation. Engineers who have studied European railway methods with an open mind, however, have been impressed with the fact that what is suited to one set of conditions may not be at all adapted to another set of conditions. The small-capacity freight cars on English railways, for example, have many advantages for handling their short-distance, small-consignment traffic, which would be lost were American 60,000-lb. or 100,000-lb. freight cars substituted. Even in American railway practice the increase in capacity of cars has on many roads more than kept pace with the ability of the operating departments and the traffic departments to keep the cars loaded to a reasonable percentage of their capacity.

On branch lines of very light traffic, say 20,000 to 50,000 tons per annum, especially those of considerable length, where low cost of track construction and maintenance is imperative, the large-capacity freight car is an economic absurdity.

Narrow Gage or Standard Gage

The older members of the profession, at least, are aware that the narrow-gage railway when first introduced was heralded as filling the long-felt want for a low-cost type of railway adapted to handle light traffic economically. Many millions of dollars were invested in narrow-gage railway construction on the strength of this fallacious idea. But, save in exceedingly rough, mountainous country, where very sharp curvature is essential, with heavy embankments and cuts, the difference in cost of construction between the standard gage and the narrow gage is trifling. The real advantage of the narrow gage in reducing construction cost is that its light cars and locomotives permit the use of a lighter track and lighter structures.

If a branch line were to be planned from the beginning with the idea that it would use its own light-weight rolling stock and not attempt to interchange cars with the standard-gage line with which it connected, there would then be no reason why a narrow gage might not be adopted instead of the standard gage.

Even in such a situation, it is difficult to make out a good case for the narrow gage. Standard-gage locomotives and cars can be built of as light weight and as small capacity as narrow-gage cars. The cost of hauling standard-gage rolling stock from car or locomotive works is much less. The small saving in construction cost of narrow-gage roadbed over that of the standard gage is often fully offset by the more careful maintenance required on narrow-gage track because of the narrower support afforded to the rolling stock.

A very practical advantage of the standard gage is the fact that all locomotive and car shops are accustomed to standard-gage work and all tools and materials are adapted to it, while narrow-gage work is special and inevitably involves greater cost of construction per ton of capacity. It is common practice, also, to use on standard-gage branch lines locomotives and cars which on account of light capacity have become obsolete for main line use.

Electric Traction Not Feasible for Light Traffic

On railways built in rough country, when it is attempted to economize in cost of construction by adopting steep grades, it becomes necessary to use locomotives of considerable tractive power to haul paying trains. These locomotives have heavy wheel loads, which require an added weight of rail. If tractive power is increased by increasing the number of coupled driving wheels, then either a limit is set to the degree of curvature which can be used or the locomotives cause heavy expense in track maintenance.

When the electric railway was first introduced many engineers felt that it opened up new possibilities in economic transportation, since it made it possible for the first time to apply power to all wheels of a car or train and thus to ascend grades up to 10 to 12%. Also, it was expected to make possible the use of lighter rails on light-traffic roads, since the heavy steam locomotive was no longer required. But for handling light traffic an electric railway is handicapped by the investment necessary for the power station and transmission lines. Besides adding very materially to the first cost of construction, the power station and transmission line establish a fixed expense for operation which has to continue for practically the entire 24 hours unless the line is able to purchase current from an existing power station.

It has seemed well to set down these general considerations, well known though they are to most engineers, since they demonstrate pretty clearly that the light-traffic railway lines cannot find salvation by conversion from steam to electric traction.

Maintenance-of-Way Expenses

The cost per mile of maintenance-of-way is one of the heaviest items in the light-traffic railway's expense account. Higher cost of ties and of track labor—two of the largest items in track maintenance—are likely to be permanent conditions hereafter. Most light-traffic railways keep down their roadway costs, through the compulsion of poverty, by sheer neglect. Lower costs will probably be secured in the long run, however, where a company can afford to invest enough in its road to provide good drainage, ballast, and creosoted ties, even if the latter are of cheaper wood. Such a track with light rolling stock and a small volume of traffic should reduce to a small amount the labor required for maintenance.

Independent Motor Cars

For handling light traffic on branch-line railways the theoretical advantages of an independent motor car carrying its own motive power, and capable of operation with a much smaller crew than a train hauled by a steam locomotive, have long been evident. For more than a quarter century, in various countries of the world, experiments have been made in the construction

and operation of such cars, often on a considerable scale.

Motor cars propelled by steam power are in fact almost as old as the locomotive. Gasoline-electric cars, in which a gasoline or oil engine drives a generator which furnishes current to electric motors which drive the car, have been extensively exploited, often in combination with storage batteries to assist the car in starting and climbing grades.

The greatest commercial success thus far attained by any type of railway motor car has been achieved by the McKeen gasoline motor car, which was originated 14 years ago by W. R. McKeen, Jr., then superintendent of motive power of the Union Pacific R.R. This car is driven by a gasoline engine with a silent chain connection direct from the engine shaft to the car axle. Over 125 McKeen cars have been built and put in service on railways in the United States and foreign countries. The Union Pacific R.R. has had the largest experience in the operation of such cars, having 20 of them in service.

Operating Expenses of McKeen Gasoline Cars

The operating sheet for the McKeen cars on the Union Pacific system for the year 1917 (the last figures published) shows average direct operating expense for these cars of 36.39c. per motor-car mile. Of this total, 17.90c. was spent for repairs, 8.29c. for fuel, 1c. for lubricants and supplies, 1.43c. for cleaning and watching and 7.77c. for motormen and other trainmen. The cars averaged 107.4 miles run per day. The failures in service averaged one for each 5236 miles run, or one for every 49 days of service. The depreciation charged for the year on the 20 cars was $15,098.40, an average of $754.92 per car or 3½c. per car-mile.

The McKeen Motor Car Co. builds cars equipped with engines of either 200 hp. or 300 hp., and weighing 66,000 to 74,000 lb. for the cars with the smaller engines and 78,000 lb. to 86,000 lb. for the cars with the larger engines. Practically all the cars built have been for passenger service, or else combination cars, with a separate compartment for baggage, express and light freight. The larger cars can be arranged for seats for 105 passengers. Assuming a car weight of 25,000 lb., this would be a weight of 724 lb. per seated passenger.

The designers of railway motor cars have, almost without exception, followed the conventional lines of railway rolling stock in their work. Therein lies the reason why the independent motor car has never attained the success for handling light traffic that has been predicted for it.

The cars are too costly for the light-traffic railways to afford their purchase. They are too heavy for light track. They are too expensive in operation, especially in the outlay for repairs; and the lost time in the shop is too great. In 1916 the Union Pacific railway motor cars averaged one-fourth of their time in the shop.

Even with this showing, the independent motor car for branch-line passenger service represents a material economy compared with trains hauled by steam locomotives. It is doubtless true, also, that the designers of these cars have built such cars as railway officers demanded. But herein lies the real root of the trouble. Little study has been given to the special problems involved in handling light traffic economically; and few have appreciated how radically different are the conditions from those on heavy-traffic roads.

The development of the automobile has revolutionized many fields of mechanical engineering, and the lessons it can teach have only begun to be learned. There is no reason why a car which rolls on smooth, steel rails need be any heavier than a vehicle which travels on highways and is constantly subjected to severe shocks; yet a motor omnibus weighing with its motor equipment only five tons may carry 50 persons while a railway car without any motor equipment and carrying 70 passengers often weighs 35 tons, or five times as much per passenger carried.

Car Designers Should Study Automobile Practice

Making all allowance for the necessity of provision for traction and buffing shocks in railway cars moved in long trains, and for other limiting conditions, it is evident that the designers of rolling stock for light-traffic railways need to study the achievements in automobile design.

There ought to be developed, for use on light-traffic branch-line railways, an independent motor car of light weight and low cost, seating 25 to 40 passengers, and with an engine of probably not over 50 to 100 hp. It should be *manufactured*, not "built," with standard parts, so that repairs and renewals could be quickly made without long detention in the shop. Such a car should handle express and package freight demanding frequent service, either in a separate compartment or in a light trailer car, hauled by the motor car. It should be possible to operate such a car in country districts, under such price standards as prevailed prior to the war, for not more than 15 to 25c. per mile. Light freight cars operated by one man could be run for even less.

There is a real opportunity here for some of the enterprise and capital now being lavishly expended in the motor-truck field, where competition is intense, to be diverted in a direction where no effective work is now being done and where the need is great.

"Rail Wagons" to Reduce Terminal Cost

The great advantage of the motor truck over the railway is in eliminating rehandling and consequent cost at the terminals. The great advantage of the railway over the motor truck is in its low cost of hauling over the road.

The Bonner "rail wagon" plan of freight transport described in *Engineering News-Record* of Oct. 24, 1918, p. 783, is a scheme to reduce the cost of terminal handling on goods transported by rail. A car body suitable for use on either a steam or electric railway is so built that freight wagons of a special type with their wheels straddling the car frame can be moved over the car body and then raised so as to rest on the car body by compressed air jacks. These "rail wagons" are loaded with goods, and then hauled by horses or motor trucks to the railway line. They are then placed on the railway car and carried to the city or town to which they are destined. Here the wagons are taken off the car and hauled through the streets to the consignee.

Of course, for long-distance rail hauls the extra weight of the "rail wagons" and the smaller capacity of a freight car loaded with them would increase the cost of the haul. For shorter distances, such as the transportation of market-garden products from out-

lying districts to a city over an interurban electric railway, the system promises to effect a large saving in the total cost of transport.

VII. The Business Organization of the Light-Traffic Railway and of Motor Truck Lines

No review of the competition between the motor truck and the railway would be complete without a word as to the contrast in their relative business positions and as to changes needed to put each on a more efficient basis. One would go far to find a sharper contrast than that between the business position of the light-traffic railway and the motor truck at the present time.

On the one hand are the truck manufacturers lavishing millions of dollars in the development of their machines and in pushing them into use, while hundreds of millions are being expended on the highways and many thousands of concerns are undertaking motor-truck operation.

On the other hand are the light-traffic railways, "dead broke" financially, unable to spend any money to better their methods or machinery, and with public opinion confirmed in the belief that the industry is a hopeless failure.

There is a partial explanation of this contrast in the fact that the motor-truck business is open to free competition, while the railway is a natural monopoly and is subject to regulation by public authority. The free field and the hope of large profit are stimulating enterprise in the manufacture and use of motor trucks, just as railway construction was stimulated half a century ago, before public regulation of the railway was established. The necessity of that regulation is now universally recognized; but few have yet perceived that, the incentive of profit having been taken from the railway business, the further development of the industry must be undertaken by public authority or it will not be done at all.

The preceding review has made it clear that the light-traffic railway has a very important place to fill in the great transportation network. How to build, maintain and operate such railways at low cost is a matter of great public moment. Instead of abandoning such railways, as is now being done, thousands of miles of such lines ought to be put under construction to give cheap transportation to regions now undeveloped. It is useless to look to private enterprise to undertake this work. The betterment and extension of the light-traffic railway, which means so much to the country's prosperity, will have to be undertaken by some Government agency.

Here is an urgent reason for the Federal Department of Transportation which has been recommended to Congress by the railway executives. The greatest hope of improved efficiency for the country's transportation machine lies in the improvement of these light-traffic lines. A Federal Department of Transportation could not begin its career with a more helpful task than this.

This matter closely concerns also the other railway problem—the destinies of the great railway systems. There is a current idea that the branch lines ought to be cut off from the great systems and left to sink or swim under local ownership and management. This idea was fostered by the action of the Government when it took over the entire railway system of the country except certain unprofitable light-traffic branch lines which it refused. In line with this idea, when the roads are returned to the owning companies, if conditions of the past are to be restored, most financiers would be only too glad to prune from the big systems many branches which are only a drain on the company's treasury.

But such a break-up and disorganization of the transportation network would be a serious blow to efficient service. The day of the little railway company as a local enterprise has gone. The necessary overhead expenses of a small organization, and the limitations in the grade of technical ability it can obtain, are among the reasons that enable a large system to lease a branch line and operate it at a profit where an independent company would inevitably fall behind. The objection of the large company to the operation of branch lines will be obviated when the principle is established that the branch line must pay its own way. The service given and the rates charged must be such as will permit this, and the operating company must not be compelled, by pressure of public opinion or by public authority, to furnish a service more expensive than shippers and travelers who use the line are willing to pay for.

Public Regulation of the Motor Truck Business

It has just been noted how greatly the free competition prevailing in the motor-truck field is stimulating its development. A close view of the situation reveals, however, that unlimited competition here produces such waste that its continuance may be to the injury of both the truck owner and the public.

The detailed analysis of motor-truck operating costs which has been given in the preceding has shown that the ton-mile cost depends much more on the volume of business than on the outlay in operating the truck.

With the fierce scramble for business which is now going on, and with new competitors all the time appearing—usually with a general ignorance of operating costs—the inevitable result is to divide up the business to such an extent that no one can obtain full truck loads, profits disappear, and the concerns which try to render a regular and reliable service find themselves unable to carry the burden which such service involves.

This situation has already been recognized in a number of states, where the business of operating motor trucks as a common carrier has been placed under control of the public service commission. The operation of motor-truck service over a given route is governed by a franchise giving one concern the exclusive right to render such service as the franchise specifies, and at agreed rates. Any such monopoly is only partial of course, since it still leaves the use of the road open to the individual truck owner carrying his own goods. It is effective enough, however, to eliminate competitive wastes.

To the highway engineer a very hopeful feature of such public control over motor-truck routes is the possibility it opens of better regulation of truck loads and speeds than has hitherto been possible. Not only will the holder of an exclusive franchise for operating a motor-truck route have his own vehicles under strict official scrutiny, but he will be on the watch for any infringement of weights and speed limits by independent truck owners attempting sporadic competition with him.

Lightning Pushes Sidewalk Off Concrete Bridge

Railing Is Also Displaced for Distance of 90 Feet and Steel Rods Are Pulled Apart in Pure Tension Break

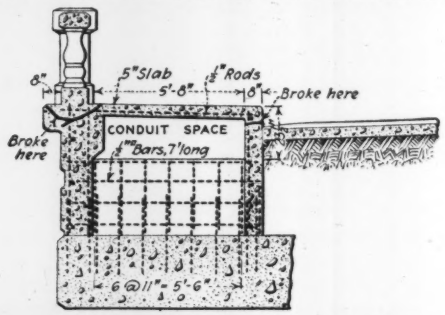
DURING a severe electrical storm on the evening of June 9, 1919, ligtning struck the Burlington St. reinforced-concrete bridge across the Iowa River at Iowa City, Iowa, and displaced the concrete railing on one side, completely severed the concrete sidewalk from the structure proper, and generally caused damage to the extent of about $3,000. The effect of the force of the stroke may be noted from the accompanying views.

HOW THE SIDEWALK PUSHED OVER BY LIGHTNING CRACKED

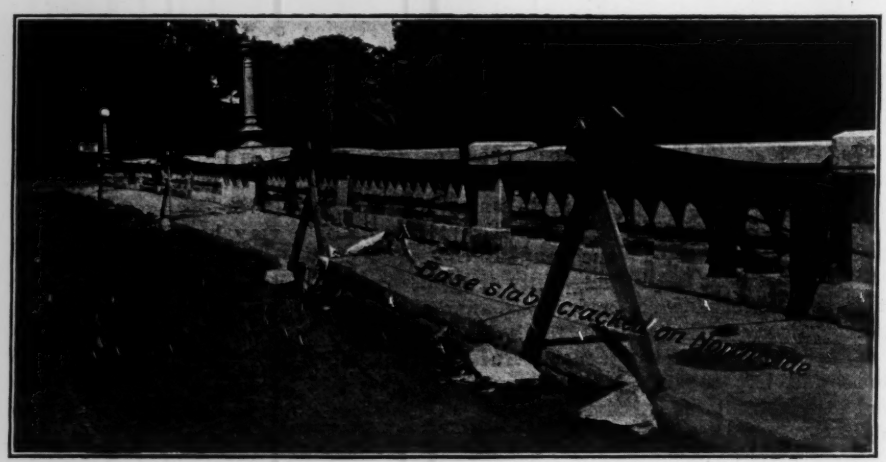
According to Stanley M. Hands, city engineer, the greatest force must have acted at the base of the handrail and in a horizontal direction. The bridge is a solid-arch reinforced-concrete structure carrying the sidewalk on longitudinal walls with regularly spaced cross walls, as shown in the detail drawing herewith. The handrail, of concrete, was carried on the outside fascia wall and tied therein by reinforcing rods. The slab itself was reinforced with ½-in. rods in both directions.

LOOKING TOWARD THE BROKEN PLACE WHERE LIGHTNING STRUCK CONCRETE SIDEWALK

As shown in the views the handrail was displaced to the north—toward the river side—and the sidewalk to the south—toward the roadway—the distance from end



SECTION THROUGH SIDEWALK AT IOWA CITY CONCRETE BRIDGE



HANDRAIL DISPLACED AND SIDEWALK BROKEN FROM CONCRETE BRIDGE BY LIGHTNING

to end of the rupture being about 96 ft. The concrete at the base of the handrail was shattered on the surface, but only a clean break about 2 in. wide shows on the bottom of the floor slab.

As stated, the sidewalk and slab are reinforced longitudinally and latterally with ½-in. twisted bars, and a conduit for gas, electric wires and telephones is provided under the sidewalk. These rods were of mild steel. The force of the shock was sufficient to pull the ½-in. twisted rods into two parts, shatter the concrete which gave the bond, and

free the rods from any support. They then fell into the bottom of the conduit with no concrete other than a skin coat clinging to them. All the lateral rods at the point of maximum rupture were pulled apart in like manner, the reduction in section being from the original ½ in. to ¼ in. According to Mr. Hands, there seems to be no explanation why the rods which were pulled apart, had none of the conrete adhering to them. This is strange, he thinks, since the concrete must have furnished the bond which held while the rods were being pulled apart.

Concentrated Load Tests of Yellow-Pine Beams for Shear

Results Show Previous Horizontal Shear Values Used in Design Too Low, and 50 Per Cent. Increase Is Recommended

By L. R. Manville and C. R. Hill

PREVAILING unit stresses in horizontal shear now in use in computing the strength of timber beams are misleading, since they have been established from tests in which two concentrated loads were applied invariably at the third points of the beam span, whereas the position of the applied loads on the beam has a decided influence on the resistance a beam offers in horizontal shear. It is the aim of this article to discuss results of experiments showing how such shear values are so influenced, in order that the computation and unit stresses used in the investigation of old beams, or the design of new beams, may be more intelligently applied. Longleaf yellow-pine beams only were tested and will be considered in this discussion.

Two Main Factors in Beam Design.

The four conditions of stress which should receive consideration in beam design are cross-grain bearing, shear across the grain, shear with the grain, and flexural bending. While the wood fibers take a permanent set at about 600 lb. per square inch in cross-grain bearing this condition is not critical. If any bearing of reasonable width and length is furnished, high bearing stresses should cause little concern, as the local distress in the timber fibers over reaction points, impairs but little the sustaining power of the beam itself. Likewise, cross-grain shear is not a critical stress, the unit vertical shear being equal to the unit horizontal shear, as wood will withstand a unit stress in cross-grain shear several times greater than in horizontal shear. With these two eliminations, timber beam design can then be confined to two considerations—flexural bending and horizontal shear along the grain of the wood fibers.

Flexural Bending—In proportioning a beam for flexural bending stresses, the procedure is familiar, and the strength of beams in bending has been well established by extensive tests—the usual unit designing stress for timber of longleaf yellow-pine grade varying from 1200 to 1600 lb. per square inch will no doubt fulfill all requirements for beams (the ratio of span length to depth of which is within practical limits), irrespective of load positions.

Horizontal Shear—The factor of horizontal shear in a beam in which the ratio of length to depth falls below 10 to 12 usually gives a more critical computed stress than flexural bending. In other words, in beams having a ratio of length to depth less than the ratio of unit stress employed in bending to unit stress employed in shear, the factor of horizontal shear should receive consideration.

Modern Tests

The latest tests, which are reported in the 1912 bulletin of the United States Forest Service and the 1909 bulletin of the University of Illinois, were applied to timber of so-called merchantable grade, passing ordinary commercial inspection. Results of these tests for longleaf yellow pine give an average ultimate bending stress of approximately 5000 lb. per square inch and an average ultimate horizontal shear of about 300 lb. per square inch. Some failures in horizontal shear occurred at 188 lb. per square inch and the reports record a large percentage of failures as taking place in horizontal shear, rather than by tension or compression in bending. As a result, design unit stresses are recommended as low as 120 lb. per square inch for longleaf yellow pine in horizontal shear. (Approved by the American Railway Engineering Association.)

Position of Applied Loads Affects Results—The tests just mentioned were practically all made with two concentrated loads placed at the third points of the beam span. No tests were made to examine the strength of the beam in shear with concentrated loads placed near the point of support where a designer would ordinarily place such a load in order to compute the maximum horizontal shear to proportion properly a given beam for shearing stresses.

It is a fact, as the tests about to be described indicate, that with concentrated loads nearer the point of support than the third point, the resistance a beam offers in horizontal shear becomes very much greater. Hence, if a designer were to determine the size of a beam required to carry a moving load by placing the load in such a position as to obtain the maximum computed horizontal shear—that is, near the point of support—and then use the low unit stress of 120 lb. per square inch (as recommended from tests based on the third-point loadings) he would in most cases find that much larger beams would be required than would be actually necessary, and a waste of material would result therefrom.

With the loads near the point of support, beams will

FIG. 1. SPECIMEN IN TESTING MACHINE SHOWING FAILURE BY HORIZONTAL SHEARING

not, in all probability, fail in horizontal shear before they fail by crushing, either under the load or over the reactions. Loads near the points of support produce local compression of the fibers, helping to resist better the tendency of the fibers to slip along each other. In the case of a single concentrated load, this local effect many be sufficient to produce enough friction of wood on wood to overcome largely the tendency toward horizontal shear movement.

In a series of tests on 31 longleaf yellow-pine timber beams of 4 x 10-in. commercial size which have recently been completed by the authors, the effects of the posi

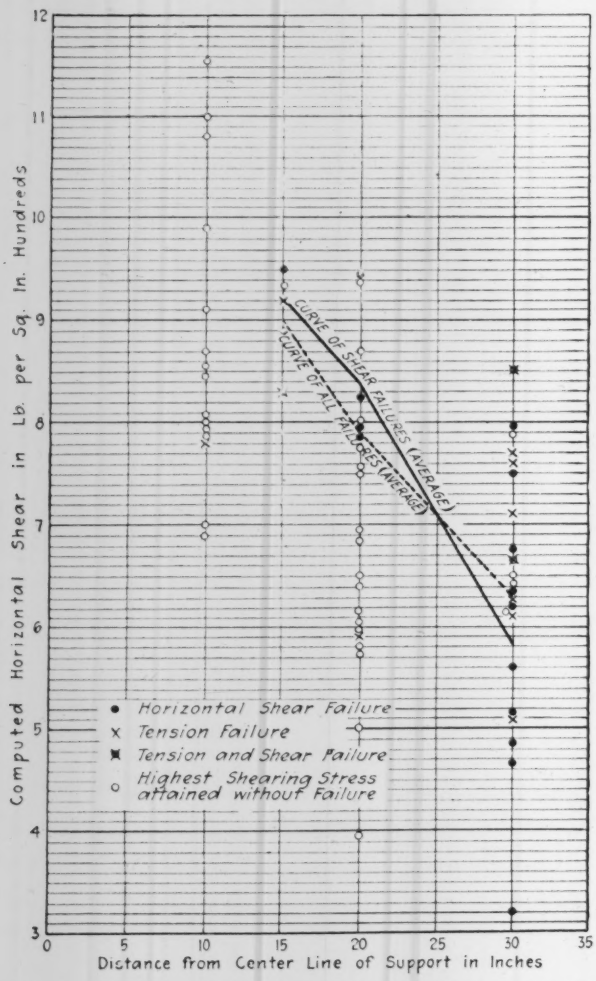

Computed Horizontal Shear in Lb. per Sq. In. Hundreds
Distance from Center Line of Support in Inches
CURVE OF SHEAR FAILURES (AVERAGE)
CURVE OF ALL FAILURES (AVERAGE)
Horizontal Shear Failure
Tension Failure
Tension and Shear Failure
Highest Shearing Stress attained without Failure

FIG. 2. VALUES OF MAXIMUM HORIZONTAL SHEARING STRESSES IN TEST BEAMS

tion of the applied loads on the beams received special study. Ten of the specimens were creosoted, and practically all of them were 8 ft. long. In general, all sticks were tested according to the following outline:

1. The loads were applied to the beam at a distance from the center line of the reaction equal to the depth of the beam. The load was relieved only when the beam showed distress in cross-grain bearing. A study was made of the distortion of the wood fibers by means of strain gages, to show the local distribution of the loads.

2. After no signs of horizontal shear failure appeared under loading 1, the center lines of the loads were moved away from the supports to a distance of twice the depth of the beam, or occasionally 1½ times this depth. In this position, care was taken to keep the stresses within the elastic limit of the material and to determine about what stresses in horizontal shear the beam was able to stand safely. In a few cases, the load was increased to failure in order to get a fair failing value with the loads in this position.

3. In the larger percentage of the sticks an effort was made to carry such specimens through steps 1 and 2, and then finally to place the center of the applied loads at a distance from the center line of the support equal to three times the depth of the beam, which is the third point of the beam used in these tests, and hence conforms to the two-point loading generally used. With the loads in this position, the beam was tested to failure in order to arrive at a reasonable comparison of the strength of the timber used in these tests with the timber used in other tests.

Results of Tests

By a comparison of the results obtained with the loads at step 3 with the loads at 1 and 2, the effect of the position of the applied load upon the resistance a beam offers to horizontal shear can be directly studied. The diagram, Fig. 2, indicates that very much higher shear values result with the load near the support. This diagram gives the maximum computed stresses in horizontal shear plotted with reference to the position of the applied load. It is upon these plotted results that the most important conclusions reached in these tests will be based.

Fig. 3. gives the results of extensometer readings

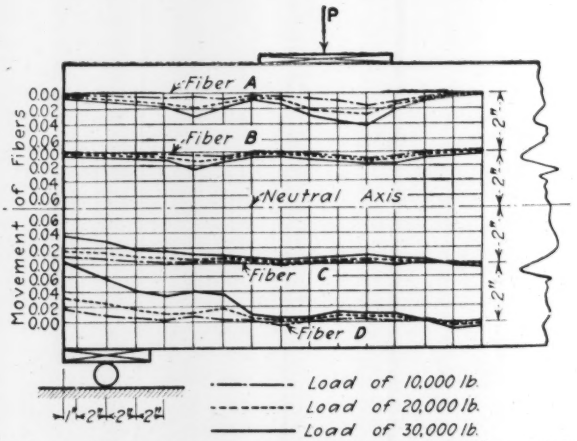


FIG. 3. DISTRIBUTION OF HORIZONTAL FIBERS NEAR SUPPORT

taken near the load points, showing how the fibers are locally compressed with the load near the end of the beam, and how such local compression may create friction which reacts against the tendency toward horizontal shear failure. Specimen 30 was tested with one concentrated load placed at various points on the beam instead of two loads symmetrically placed. The results indicate no change due to this manner of loading. Beam 31 was tested after the stick had been sawed in half along the neutral line. An attempt was made to measure the loads carried, before slipping took place along the neutral axis. No consistant results were obtained, but the beam carried a considerable load, due

to the friction between the halves of the beam and along the neutral axis, before slipping took place.

Comparison With Other Tests—The average horizontal shear failure in these tests with loads applied at the third points of the beam span was 580 lb. per square inch, which is considerably higher than the results obtained by the Forest Service as reported in the 1912 bulletin, or the University of Illinois in its 1909 bulletin. Their results averaged around 315 lb. per square inch. Photographs of their test specimens, however, indicate large knots and irregular graining in many sticks such as would lead one to believe that the timber would not exactly qualify under the inspection

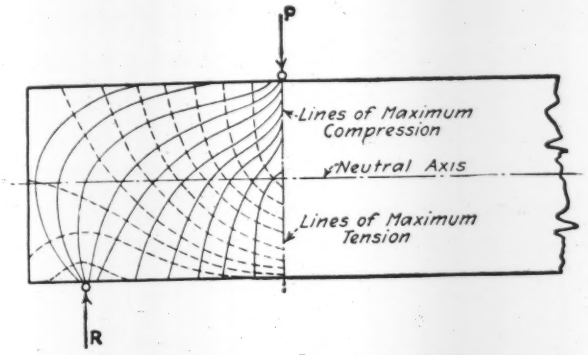


FIG. 4. LINES OF COMPRESSION AND TENSION SHOWING EFFECT OF LOAD DISTRIBUTION

requirements of the U. S. Forest Service—1915—used for the selection of beams here reported.

Observations and Conclusions

1. These tests bear out the fact that with a concentrated load placed a distance from the end support of a beam equal to the depth of the beam, the beam will hold as much as the timber will stand in cross-grain bearing over the supports, and that no horizontal shear failure may be expected. Deflection in a beam is necessary before horizontal shear failure can result; in other words, there can be no tendency toward horizontal slipping of the wood fibers unless there is an accompanying vertical deflection, and such deflection is relatively small with the load near the support.

2. It is recommended that for the strength of beams in horizontal shear values roughly 50% greater than ordinary design unit stresses may be used if the unit shear is computed by the usual method, if heavy concentrated loads occur near the point of support, or within, say, 1½ times the depth of the beam.

3. Design unit stresses in horizontal shear such as 120-lb. per square inch for longleaf yellow pine appear to be very conservative for application to maximum end shear under concentrated loads, although no doubt within safe desig limits with a load three depths of the beam from the support. This stress could be increased as recommended above for applied loads nearer the reaction.

4. Timber inspected and graded under the rules proposed by the United States Forest Service, dated 1915, which would largely eliminate critical defects, may be used with higher unit stresses, especially in horizontal shear in which defects such as checks and shakes so often play an important part.

Rainfall Records at Muscatine, Iowa

RECORDS of 73 years of rainfall and melted snow show an annual average of about 37 in., a maximum of 74.5 in. in 1851 and a minimum of 23.04 in. in 1910, according to a paper presented at the meeting of the Iowa Section of the American Water Works Assiation by William P. Molis, superintendent of waterworks, Muscatine, Iowa. For the first 30 years the annual average was 39.34 in., while for the second 30 years it was 36.88 in. The maximum and minimum monthly records were 8.58 in. for September, 1911, and 0.12 in. for November, 1914. One of the accompanying tables gives the complete 73-year record, while the other shows all rainfalls since 1900 in excess of 15 in. in 24 hours.

TABLE I. AVERAGE RAINFALL AND MELTED SNOW AT CA TINE, IOWA, FROM 1846 TO 1919

Year	Inches	Year	Inches	Year	Inches
1846	34.55	1872	35.41	1896	34.4[illegible]
1847	28.50	1873	28.43	1897	49.7[illegible]
1848	39.62	1874	34.78	1898	34.08
1849	59.16	1875	37.59	1899	27.26
1850	49.08			1900	32.30
1851	74.50	Average	34.63	1901	24.50
1852	59.39			1902	47.57
1853	44.92	1876	53.57	1903	33.68
1854	23.66	1877	44.78	1904	28.22
1855	31.13	1878	39.30	1905	32.59
		1879	33.83		
Average	44.45	1880	35.78	Average	34.44
		1881	45.66		
1856	41.94	1882	46.67		
1857	34.85	1883	41.12	1906	29.51
1858	58.45	1884	45.49	1907	34.26
1859	35.96	1885	39.34	1908	38.31
1860	25.10			1909	37.62
1861	44.23	Average	42.55	1910	23.04
1862	53.16			1911	39.40
1863	28.83	1886	34.22	1912	26.50
1864	32.77	1887	28.30	1913	30.94
1865	34.21	1888	38.89	1914	23.67
		1889	33.49	1915	35.70
Average	38.95	1890	30.30		
		1891	34.90	Average	31.95
1866	32.86	1892	49.71		
1867	32.24	1893	30.68	1916	33.29
1868	40.91	1894	27.82	1917	26.07
1869	43.36	1895	28.09	1918	37.44
1870	24.61				
1871	36.11	Average	33.64	Average	32.27

TABLE II. RAINFALL OVER 1.5 IN. IN 24 HOURS SINCE 1900 AT MUSCATINE, IOWA

Dec. 12, 1904	2.00	Aug. 15, 1908	1.65	Sept. 5, 1914	2.20
Dec. 27, 1904	1.56	Aug. 28, 1909	2.47	May 26, 1915	2.05
Jan. 6, 1905	1.50	June 10, 1909	1.70	Sept. 10, 1915	2.80
June 9, 1905	2.57	Aug. 27, 1909	1.90	Jan. 26, 1916	1.75
July 1, 1905	1.78	Nov. 7, 1909	1.54	Mar. 26, 1916	1.95
Oct. 16, 1905	2.77	July 28, 1911	1.55	May 14, 1916	2.02
May 23, 1907	1.45	Sept. 11, 1911	2.00	Sept. 7, 1917	1.50
July 8, 1907	1.86	July 20, 1912	1.77	May 23, 1918	2.00
July 10, 1907	2.10	Oct. 10, 1912	1.94	July 6, 1918	2.35
Aug. 15, 1907	1.85	May 1, 1913	2.50	Aug. 17, 1918	1.80
Aug. 11, 1908	3.15	June 22, 1914	1.54	Mar. 16, 1919	3.50

Approximate Timber Resources of the United States

Until a complete census of our timber resources is made, the United States Forest Service states, it hesitates to make any estimates as to the number of years the supply of timber will last, "as there is not available in the United States today reasonably accurate knowledge regarding our remaining timber stands and the rate of growth on cut-over lands. Timber estimates have been made from time to time in various parts of the timber areas of the United States, but different methods were followed, and none of these estimates has been complete in regard to areas covered for the regions that supply the timbers. Roughly, however, the present stand of cypress is estimated at 25 billion board feet; sugar pine, 35 to 40 billion; Eastern red cedar, 1½ to 2; basswood, 8 to 10; yellow poplar, 10; red gum, 40 to 45; Port Oxford cedar, 1 to 2; Eastern white pine, 25; Western white pine, 20 to 25; Eastern spruce, 25; Sitka spruce, 10 to 12; Englemann spruce, 25 billion."

Visualizing the Recent Pandemic in Army Camps

Use of Spot Maps, Growing Columns and Case-and-Rate Curves for Studying Progress of Influenza and Pneumonia in Cantonments and Other Stations

By George A. Soper,
Major, Sanitary Corps, United States Army

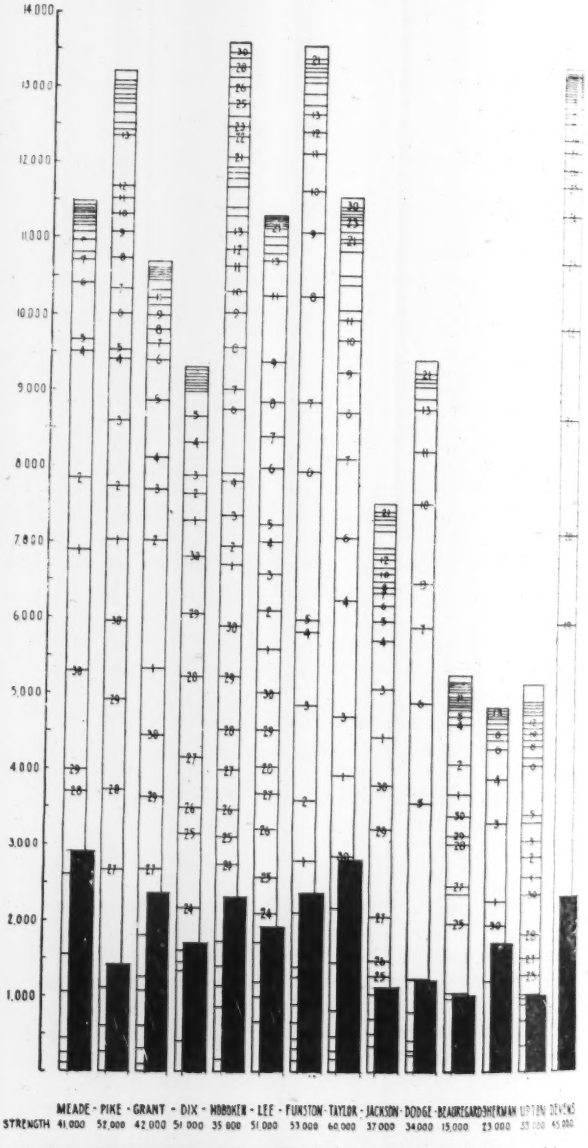
AMONG the manifold uses to which graphic representations of data may be put, none is of greater interest or importance than the illustration of statistics of disease. By this means the progress of an epidemic may be traced from its beginning to its end, its increase or decrease may be detected, and its magnitude compared with the magnitudes of other outbursts. Any peculiarity which makes one outbreak different from others of its kind, or from what might be expected, can be detected instantly. In this way the effect of repressive measures may be studied and clues obtained as to the conditions which accelerate and retard the spread of infection.

It was with these ideas in view that a system for visualizing the pandemic of influenza and pneumonia in the United States Army camps was instituted in the office of the Surgeon General in the early part of September, 1918. As soon as it became apparent that the pandemic constituted a serious danger to the camps, a scheme was devised by which the rate and conditions of spread could be observed continuously. The information which furnished the basis of this scheme was gained through a system of telegraphic reports. Each day a telegram was received from every camp or station where troops were located; it gave the number of new cases of influenza and pneumonia that had occurred in the preceding 24 hours. Another series of telegraphic reports received each week from the same sources provided a check on the number of cases of influenza and pneumonia and gave also the number of deaths which had occurred in the preceding seven days. From these two series of reports sets of tables were prepared and graphs were made to illustrate the facts.

The data obtained from the telegraphic reports were not entirely accurate. In many instances the immense amount of work which was put upon the camps in providing for the immediate needs of the sick made it impracticable to make up precise statistics of each day's occurrences. Nor was any great precision necessary. In the course of time, records deliberately made, revised and final would appear in the annual report of the Surgeon General, in the medical history of the war and in various particular reports and papers. What was wanted at the time from each camp, and what was obtained, was a good working knowledge of the number of cases and deaths which occurred from day to day. The data which are given in this paper, therefore, are to be taken not as the final records but as the best information which was available to the Surgeon General at the time when the pandemic was in progress.

The graphic work may be divided into four main parts: (1) A spot map showing where and how the disease was progressing across the United States; (2) growing diagrams which showed the daily increase in the number of cases and the deaths at the several camps and other stations; (3) a series of curves showing for each camp and other station the daily progress of the pandemic plotted to an accurate scale; (4) a series of diagrams of an analytical type, the object being not merely to illustrate, as in the previously mentioned graphic work, but to study some of the more important details of the several epidemics as they were reported. It is to this fourth group that attention is here invited.

1. *The Spot Map*—The foundation of the spot map was a map of the United States prepared by the Department of the Interior on a scale of about 40 miles to 1 in., lithographed on white paper. The outside dimensions were about 7 x 5 ft. This map was colored in low tones,



DAILY INCREASE IN INFLUENZA AND PNEUMONIA CASES AT PRINCIPAL ARMY CAMPS

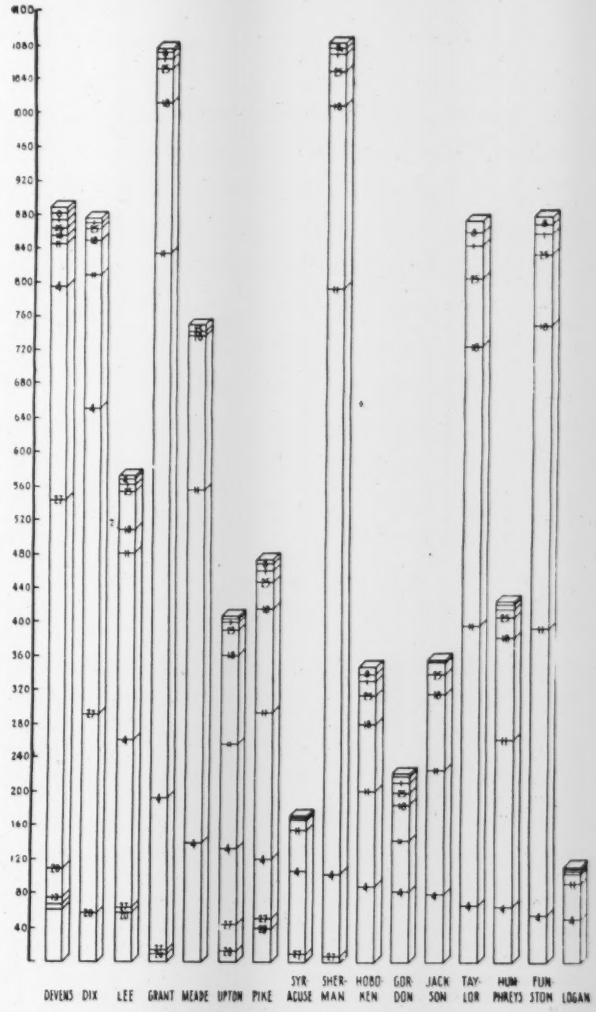
As new cases were reported they were added to the top of the "growing columns." The numbers on the columns are days of the months of September and October, 1918

in order that the several states might be easily and separately distinguished and the rivers and other details of the foundation be not unduly prominent. The names of the camps and other stations were typewritten upon heavy paper and cut out and pasted upon their proper places on the map to show the locations of the troops. The color of these slips, which were about ½ in. x 1 in., indicated the type of camp; white was employed for a tent camp, brown for a barrack camp, or, as it is generally called, a cantonment; blue was an aviation field, pink a port of embarkation, yellow was a general hospital, green was an arsenal, etc.

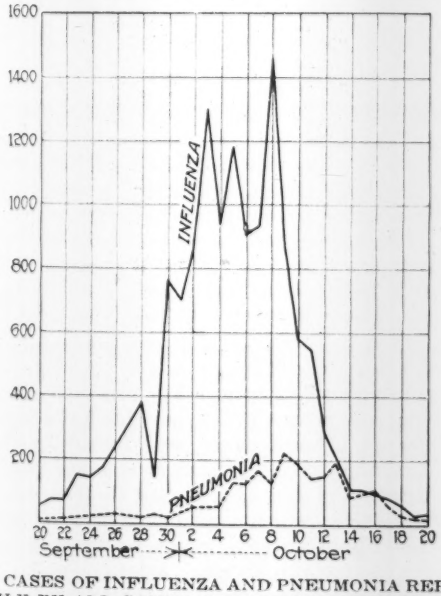
As soon as it became apparent that an epidemic had started at any point that place was spotted, and received two cardboard tags mounted on the ends of separate pins 1½ in. long. One-half of each tag was red and the other blue, the colors representing influenza and pneumonia, respectively. One tag was square, about ½ in. to the side, and the other was long, measuring ½ x 1½ in. On the short tags was written the number of cases, if any, which had occurred during the preceding week. On the long tags was given the number of cases reported from day to day. The tags were revised every 24 hours and completely changed each week.

2. *The Growing Diagrams*—The growing number of cases at the several camps was plotted upon cross-section paper about 3½ ft. high and several feet wide, fastened to the wall. The record of each camp was plotted as a rising band of red ⅜ in. wide. The number of cases reported each day was added to the top of the column as the epidemic progressed. Each top line, and former top line, became a guide to the relative rate at which the number of cases increased. A series of black columns, or bands, made in the same way, was plotted on the same piece of paper to show the cases of pneumonia which were reported. At the bottom of the columns were the names of the camps and their total strength. The vertical scale of cases and of deaths was 500 to the inch.

Deaths were indicated by a diagram approximately uniform in size and in method of plotting with the diagrams of cases. The rising columns were plotted as isometric solids and colored gray. The vertical scale was 40 deaths to the inch.



WEEKLY PNEUMONIA AND INFLUENZA DEATHS AT ARMY CAMPS, SEPTEMBER AND OCTOBER, 1918



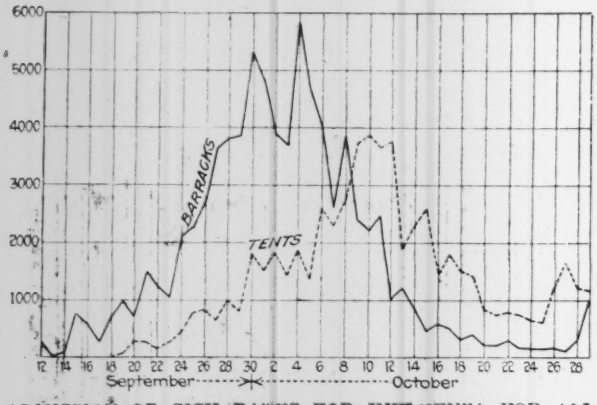
TOTAL CASES OF INFLUENZA AND PNEUMONIA REPORTED DAILY BY ALL CAMPS AND OTHER STATIONS FOR MAXIMUM MONTH IN 1918

3. *The Progress Curves*—Curves representing the progress of each epidemic were plotted on section paper divided in inches and tenths. The horizontal scale was 0.2 in. per day; the vertical scale was 200 cases to the inch. In this way the daily incidence of influenza and pneumonia were plotted together, the influenza curve being in red ink and the pneumonia in blue.

4. *Analytical Graphs*—As the pandemic progressed it seemed desirable to represent the epidemics in the various camps not by the number of cases and deaths alone, but by these figures in relation to the number of troops present in the camp in each case; that is, by rates. This would eliminate irregularities due to changes in the total number of troops from which the sick were drawn. The rates were therefore calculated and were plotted in the same manner here described for the curves which represented the incidence of cases. The horizontal scale was ½ in. to the day; the vertical scale was 1 in. per 1500 cases per year per 1000 of strength. The medical department calculates practically all its

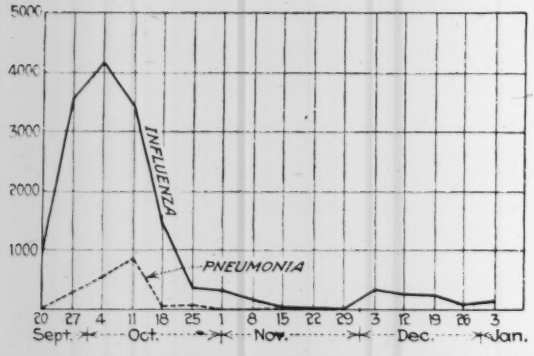
rates on the annual basis and as so many cases or deaths per thousand.

The curves made from the daily reports represented certain irregularities, and it soon became apparent that the daily telegraphic reports were not always accurate representations of the daily incidence of cases. To overcome these inaccuracies as far as possible smooth curves of incidence were made for each camp.



ADMISSION OR SICK RATES FOR INFLUENZA FOR ALL BARRACK AND TENT CAMPS

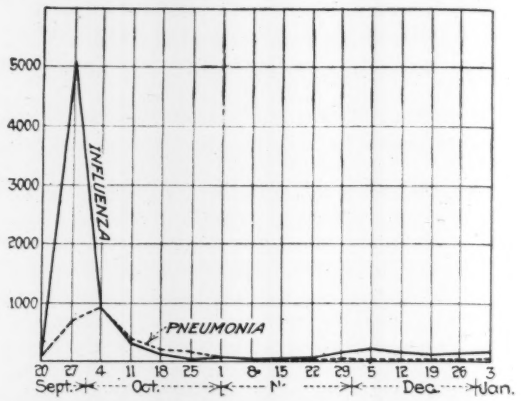
Early in the pandemic an attempt was made to establish a curve which would represent a typical epidemic in the average camp. It was thought that if this could be prepared it would be useful in foretelling the probable course of an epidemic in a given place. In order to make this typical curve the records of seven early and seriously affected camps were brought together in the following manner: The day of the epidemic's maximum prevalence was used as the datum. From this point forward to the end of the epidemic and back-



WEEKLY SICK RATES FROM INFLUENZA AND PNEUMONIA AT CAMP LEE, 1918

ward to its beginning, the average number of cases for the seven camps was plotted from day to day for nine days. The result was a composite curve of the daily incidence of influenza cases. A similarly typical curve was made for pneumonia. The two were plotted on the same sheet, the influenza in red and the pneumonia in blue. They proved to be very useful.

A number of interesting curves were made to represent the pandemic as a whole. Thus, the daily rates of incidence for the barrack camps were compared with the daily rates of incidence for the tent camps; it was found that the tent camps had much less influ-



EXPLOSIVE TYPE OF OUTBREAK AT CAMP DIX SHOWN BY WEEKLY SICK RATES

enza and their epidemics occurred later than was the case with the cantonments.

Finally, attention is again invited to the fact that the examples of graphic work which accompany this article are based on the statistical data which were sent to the Surgeon General of the Army in the stress of the pandemic and are not presented as final, official and complete records.

The New York State "Healthmobile"

At the Public Health Conference recently held at Saratoga Springs, N. Y., under the auspices of the State Department of Health, there was exhibited for the first time a "healthmobile," built for the educational work of the department. According to an official statement, "this is an automobile built especially for the purpose, and equipped with a stereopticon, a moving-picture machine run by power developed in the "healthmobile," and a number of interesting exhibits demonstrating the value of maintaining health and preventing infection. It is planned to send the "healthmobile" with a lecturer into communities remote from the railroads, so that people in the rural and sparsely settled parts of the state may have the same means of public-health education as is available to city dwellers."

St. Paul Meters 91.8 Per Cent. of Water Service

Water meters in St. Paul, Minn., handle 91.8% of the service, 97.7% of the domestic and industrial consumption and 65.8% of the total consumption, while 92.11% of the receipts for water is through metered service, and the revenue from sale of water is 72.66% of the Water Department revenue from all sources. At the end of 1918 there were 34,962 domestic meters and 2418 commercial meters, the latter of 1-in. size and larger. These averaged 136 and 2676 gal. per day, respectively. The average daily consumption was 61 gal. per inhabitant, 77 gal. per consumer and 395 per tap. The cost of supplying water was $37.66 per 1,000,000 gal., figured on the total maintenance, and including also interest on bonds and sinking fund, it was $69.24. These figures are from the annual report of the Board of Water Commissioners, which explains, however, that the city supplies only about 60% of the water consumption. The balance is from individual artesian wells, which have no direct connection with the water-works system and which, for the greater part, supply large consumers.

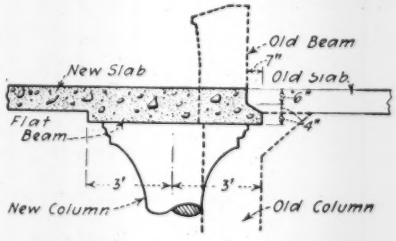
Concrete Building Addition Made at Reasonable Cost

Wartime Work Ran About Fifteen Cents Per Cubic Foot—Old Wall and Columns Torn Out and New Slab Joined to Old

THE total cost of building a large reinforced-concrete addition to a reinforced-concrete building in the Boston district during the war was found to be surprisingly low, in spite of high material and labor unit costs. The addition was made by the Hallet-Grant Construction Co., of Boston, for the A. C. Lawrence Leather Co., at Peabody, Mass. Leaving out some assistance noted hereafter from the owners' engineers, the shell of the building without the service appurtenances amounted to about 15.4c. per cubic foot. This included the cost of tearing out an old end wall and a line of columns, which about balanced the cost of building the usual fourth wall, which in this case was not necessary.

The new work was an 82 x 90-ft. addition to the old seven-story and basement reinforced-concrete building shown in the view. The end torn out had reinforced-concrete columns, with brick curtain walls and steel sash. The work was carried on between January and June of 1918, when the company had a large number of war contracts, and it was necessary to operate all of the old building possible, particularly in the second and third floor, where space clear up to the wall was required. Partitions were put up, as noted in the picture, in these two floors, but carried back a panel in the upper floor.

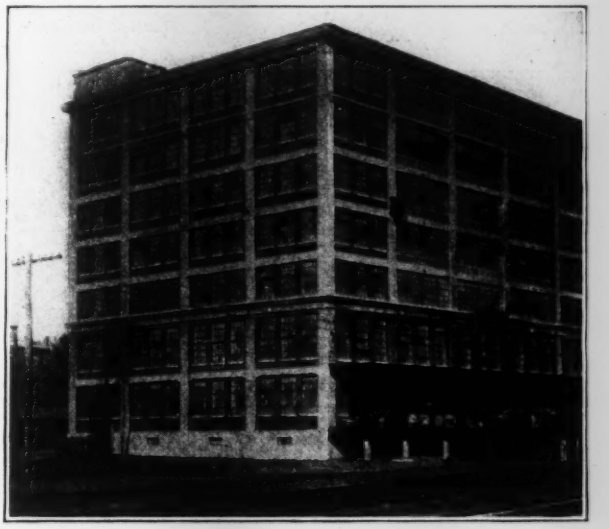
The owner wished to have the old square wall columns replaced with new round columns and to continue the two-way flat-slab system of the old floors through into the new structures. The work of carrying all of this old part out had to be completed before the new foundations for the addition could be put in place, as it was impossible for men to work near the old building on account of the danger of material dropping from above. However, the general excavation, which was about a



DETAIL OF CONNECTION OF OLD AND NEW FLOOR ON LAWRENCE, MASS., CONCRETE BUILDING

6-ft. cut in filled material, was carried along as near to the old work as possible, and some of the distant foundations were also put in. This method of jumping around with the excavation and foundation work tended to make the cost of these items even more than they would have been if the work could have been carried on more evenly. All foundations for the columns were excavated to 9 ft. below basement grade, mostly through muck, which necessitated sheathing each hole about 12 ft. square. A good gravel foundation was found at the required depth, so that it was unnecessary to go deeper than the nine feet.

The new structure was designed to carry 300 lb. live load for the first floor and 250 lb. for the floors above. A two-way flat-slab system was used throughout for the floor, the juncture of the new and old slabs being as shown in the accompanying sketch. The old columns, as noted above, were all torn out and the overhanging slabs carried on struts clear through to the basement. New columns were then placed, carrying a complete transverse beam 14 in. deep and 6 ft. wide, bracketed out to carry the old slab, rods from which were left to penetrate into the new slab. The transverse beam was of such width as to simulate on its outside edge the line



FOUR BAYS ADDED AT END OF REINFORCED-CONCRETE BUILDING FOR LAWRENCE LEATHER COMPANY

of the drop head to the flat slab in the other part of the floor.

The building was comparatively simple except for a 15-in. reinforced-concrete wall forming the basement wall and a heavy cornice and a belt course to complete the appearance of the older part of the building. There was one smoke tower, one concrete stairway and one elevator shaft. The shaft and tower were inclosed in 6-in. tile block, the tower being plastered on both sides and the elevator shaft on one side only. There were two penthouses on the new construction, the wall being of plastered terra-cotta blocks and the roofs being of concrete.

The exterior walls of the building were 12-in. panel brick walls, the face brick costing $26.75 per thousand and the common or backing brick $16 per thousand. Some few of the panels were 8-in. reinforced-concrete. Steel sash were used on concrete sills, the lights on the street side and two of the bays on the side away from the railroad track being of ¼-in. ribbed wire glass, while the rest of the sash was glazed with ¼-in. ribbed plain glass.

Labor conditions were the same as practically all over the country from June, 1918, to January, 1919. Common labor was paid at the rate of 50c. per hour, with time and a half for overtime. To hold the labor at all, it was found necessary that they receive quite a little overtime each week. Carpenters were paid at the rate of 70c. per hour, brick and tile layers, concrete finishers, and mechanics at the rate of 75c. per hour, all with double time for overwork. It was figured that there

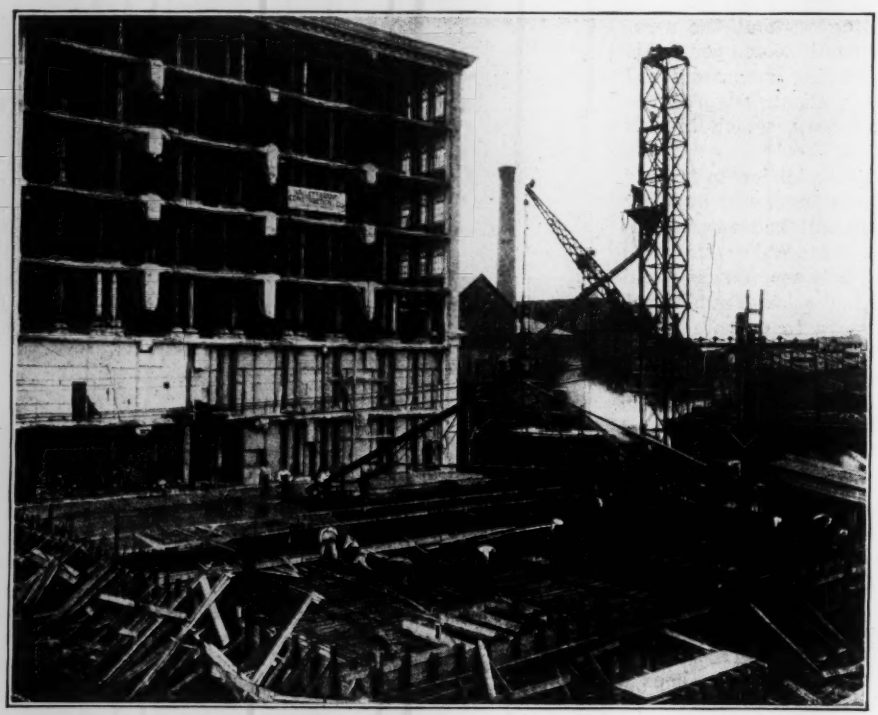
were about 14 complete gangs on the work. The plastering, paving, steel-sash erection, plumbing, fire-door erecting and roofing were sublet.

Cement was delivered in bulk, with a saving, according to the contractors' figures, of about 25c. per cubic yard on the concrete. Stone was delivered by truck from a nearby quarry, and sand was shipped in on railway cars. The reinforcing steel was purchased by the owner.

The total cost, with the exception of the sheathing, cold-water paving, electric wiring, sprinkler system and elevator, was $100,108 for a cubical content of 658,000 cu.ft., which figures a unit cost per cubic foot of 15.4c. According to the contractor, the unit cost compared favorably with work done a few years ago when labor was receiving about half of what it receives on this work. The average unit prices for labor only on parts of the work are shown in the following table:

Concrete mixed and placed	$1.10	per cubic yard
Reinforcing steel in place	15.90	per ton
Forms in place	.107	per square foot
Brick face and common combined	15.60	per thousand
Granolithic finish	.105	per square foot
6x12x12-in. tile	.112	per square foot

All concrete was mixed in a ½-yd. mixer and placed from the spouting system shown in the view. Brick and tile were raised to the floor by machinery. In fact, the handling of all material on the job was done as little as possible by hand. Another saving was made by using corrugated metal for the floor forms in place of wood. The contractor states that the work ran along very well, and the low costs were largely due to the coöperation of the engineers and owner's engineer. He gave them every possible help. The plant also furnished steam to the construction boilers without cost to the contractor.



ADDITION TO CONCRETE BUILDING REQUIRED THAT OLD WALL COLUMNS BE TORN OUT

Gravel Aggregate Does Not Make Fire-Resistive Concrete

Fireproofing Committee of Concrete Institute So Concludes, From Tests and Experience, in Report Made to Last Convention

GRAVEL, particularly highly siliceous gravel, has been shown to be a poor sort of aggregate for concrete which may be subject to fire, according to the report of the Committee on Fireproofing of the American Concrete Institute, Walter A. Hull, chairman. The report was presented to the recent annual convention of the institute. The report summarizes the recent tests made by the Bureau of Standards, discussed in detail by Mr. Hull at the same convention, and summarizes, in the following paragraphs, these tests and structural experiences with gravel concrete:

The Bureau of Standards' column tests show, quantitatively, the relative effects of a standard four-hour fire test on various types of columns made with concrete from various aggregates. A thickness of 1½ in. of concrete was provided, outside of the steel, in all cases. The steel was probably more accurately placed in the forms than could ordinarily be expected in actual building operations. In most of the 18-in. round columns, temperatures between 550 and 600° C. (1022 and 1112° F.) were reached in the steel at the end of the four-hour fire test. In the 16-in. square columns, temperatures in the steel were above 600° C. (1112° F.). Steel at these temperatures has lost a large part of its strength. It is evident, therefore, that 1½ in. of protective concrete is not sufficient thickness for the proper protection of the steel where four-hour protection is required.

In three columns in which the protection had been increased 2½ in. by the addition of cement mortar in the form of plaster, with light mesh reinforcement, the temperatures in the steel at the end of the test were approximately 400° C. (752° F.). It is, therefore, recommended that in concrete columns where four-hour protection is required, protective material not less than 2 in. in thickness be provided, over the steel. In columns in which a high percentage of steel is used, increasing the importance of affording it ample protection, the thickness of protective material should be 2½ in. for four-hour protection, and special care should be given to the accurate placing of the steel in the forms, to avoid inadequate protection on one side.

Gravel Aggregate in Conflagrations

Previous fire tests have indicated that there is an important difference in the fire-resistive properties of different aggregates. Ira H. Woolson, in his final report to the American Society for Testing Materials of investigations of the fire-restistive properties of concrete made in 1905, 1906 and 1907, reported adversely on the pure quartz gravel which is extensively used in the vicinity of New York City. Shortly afterward, the British Fire Prevention Committee

reported adversely on the behavior of gravel concrete in a fire test of floor arches. Further evidence was developed by tests made by the Bureau of Standards and reported to the American Society for Testing Materials in 1917. These test results have been so consistent that it appears to have been well established that the physical properties of gravel, that is high in quartz content, are not such as to make it as suitable as other aggregates for fire-resistive concrete.

Investigation of the failure of concrete construction in recent severe fires clearly indicates that the damage was much greater than would have been the case if any one of a number of aggregates, other than gravel of high quartz content, had been used. This was especially true in the case of the fire at Far Rockaway, New York. This fire has been thoroughly investigated. A complete report of the fire and of the condition of the building, with conclusions attributing the damage in large part to the pure quartz gravel aggregate, was prepared for the National Board of Fire Underwriters by its consulting engineer, Ira H. Woolson. Copies of this report are obtainable. A further investigation was made by a special committee of the American Concrete Institute and a report presented by Richard L. Humphrey, dealing with the fire, the condition of the building and the methods used in reconstruction. Great importance was attached to the nature of the aggregate in this report.

To this evidence may be added that of two great factory-building fires which occurred in London in 1917. Both of these latter fires were of great severity and long duration. Both were started by an explosion. It was impossible to determine how much of the damage was caused directly by the explosion, but after thorough investigation the British Fire Prevention Committee attributed a large part of the damage to the inability of the Thames ballast (gravel) concrete to withstand the destructive stresses of a severe fire, as is shown by their reports, from one of which the following two paragraphs may be quoted:

"It is clearly shown that Thames ballast or gravel concrete is an unsuitable material for reinforced concrete in buildings where the risk of a severe fire has to be considered.

"Where a suitable aggregate or combination of materials is used in the future and the reinforcement accorded proper protection, only superficial damage need be expected, i. e., damage repairable without extensive reconstruction."

In the fire tests of concrete columns made by the Bureau of Standards, gravel-concrete columns were shown to be greatly inferior in fire resistance to columns having some other aggregates. While this applies to all types of columns, the contrasts were greatest in round columns, vertically and spirally reinforced, and in vertically reinforced square columns. It is probable that similar results would be obtained from all gravels made up largely of highly siliceous materials such as sandstone pebbles, quartz pebbles and granite pebbles.

Recommendations for Fire-Resisting Aggregate

It is clearly indicated that serious structural damage by fire in concrete buildings could be prevented in large measure by using, where it is economical to do so, either limestone, trap rock, blast furnace slag or burned clay aggregate and, where none of these aggregates can be used economically, by paying special attention to certain structural details. In the case of columns, there is evidence that vertically reinforced round columns, without spiral, resist fire better than square columns without spiral. This applies particularly to gravel-concrete columns. It does not appear to be true of columns made from the more suitable aggregates. Gravel-concrete columns having spiral reinforcement appear to be particularly susceptible to spalling. It has been found that the addition of 1 in. of cement plaster, held in place by light metal mesh, was sufficient to prevent the loss of the protective covering by spalling in the case of spirally reinforced gravel-concrete columns, and that columns so protected lost but little of their original strength in the four-hour test. There seems to be added merit in such protection in the fact that the thickness is uniform over the columns, whereas any inaccuracy in placing steel would result in protective concrete being thinner on one side than on the other.

The following recommendations are therefore made, pending further developments along this line:

1. That for fire-resistive construction, limestone, trap rock, blast furnace slag and burned clay be given a preference over highly siliceous gravels.

2. That in cases where gravel aggregate is to be used, with no additional protective material over the concrete, round columns be given a preference over rectangular ones.

3. That where gravel aggregate is used, all columns, but especially rectangular columns and round columns with spiral reinforcement, be given the additional protection of approximately 1 in. of portland-cement plaster either on metal lath or reinforced by light expanded metal.

Character and Cost of Highways For Motor Truck Use

Will Have Concrete Foundations, Will Be Not Less Than 20 Feet Wide and Will Cost From $35,000 to $40,000 per Mile

By S. Whinery
Civil Engineer, New York City

WHILE much is being written and said about the necessity of designing and building highways strong enough to withstand safely the use of heavy motor trucks, not much attention seems to have been given to the definite character, strength and dimensions of roads suitable for the purpose. No one is yet prepared to say with confidence what kind of road surface ultimately will be found best and most stisfactory for power-truck use. It seems reasonably certain that it will have a concrete foundation, and quite probable that it will be wholly concrete laid in two courses, with a comparatively thin surface treatment of liquid bituminous material and stone chips or gravel, to shield the concrete from abrasion, and renewed occasionally as may be necessary. Whatever the surface may be the concrete foundation must be largely depended upon to support safely the loads to be carried. With a minimum desirable width of surface of 20 ft., and trucks not greater than 7½-ton capacity, roads will probably cost from $35,000 to $40,000 per mile.

In considering the necessary thickness of a concrete-road foundation, it is not wise to place much confidence in the strength or supporting capacity of an earth subfoundation. Unless more care than is usual, or perhaps practicable, is taken in its preparation, it is likely to vary materially in uniformity and density in adjacent areas, and to settle or compress so unequally that the concrete over considerable areas will receive little or no support. The causes that lead to such irregular depression and settlement are so well understood by engineers that it is unnecessary to go into details.

In the great majority of cases, when a concrete foundation has broken down, it has been found to be due to the yielding or settling away of the subfoundation. The liability to yield or compress will increase with the intensity of the pressure, and, considering the inherent natural variations in strength and the probabilities of faulty preparation, it would seem to be prudent in planning streets and roads for the concentrated load of power trucks that the concrete foundation should be designed to carry safely the loads without support

from the subfoundation over circular areas at least 4 ft. in diameter.

Under such conditions, the concrete foundation acts as a circular plate fixed at its edge and loaded at its center. Many attempts have been made to analyze and formulate the stresses upon such plates, but, judging from the lack of agreement in the results reached, some of them differing more than 50% from others—it it is evident that the problem has not yet been satisfactorily solved. Nearly all the solutions proposed agree, however, in the introduction of a factor making the thickness a function of the square root of the load. This is rational, following as it does the accepted law of the strength of beams.

It has been suggested by the writer to the United States Bureau of Standards that the great industrial and financial importance of the proper design of pavement foundations would warrant that bureau in undertaking an adequate investigation of the strength of circular slabs of concrete fixed at their edges and loaded at their centers, and the devising of an empirical formula for their strength, but this would require considerable time. In the absence of any established or generally accepted solution, it seems proper to determine the thickness of concrete-road foundations upon the principle that this thickness varies with the square root of the concentrated load.

Now, experience has fully demonstrated that, for roadways designed for animal power service, where rear-wheel loads seldom exceed 2000 lbs.. a foundation of 1: 3: 7 concrete, 6 in. thick, is none too strong. In fact, many engineers advocate and specify 7 or 8 in. But accepting 6 in. as a sufficient thickness under a wheel-load of 2000 lb., and applying the principle that for other loads the thickness should be proportionate to the square root of the load, we obtain the following results for some common power trucks:

3½-ton truck, rear wheel load 5700 lb.
$\sqrt{2000} : \sqrt{5700} :: 6 : 10.13$
5-ton truck, rear wheel load 8500 lb.
$\sqrt{2000} : \sqrt{8500} :: 6 : 12.37$
7½-ton truck, rear wheel load 10,500 lb
$\sqrt{2000} : \sqrt{10500} :: 6 : 13.75$

Impact Not Considered

These figures make no allowance for increased impact due to the much higher speeds at which the power trucks are operated. Loaded horse-drawn wagons seldom exceed 3 miles per hour, while loaded power trucks average three or four times that speed. While no velocity factor appears in most of the impact formulas accepted by bridge engineers, there is reason to believe that it is a factor of some importance in the effect of vehicle wheels on the more or less uneven surface of highways, and it would seem wise to make some allowance for it in designing roads for motor-truck use.

However for further discussion assume, in round numbers, that foundations of plain concrete for roadways designed for the use of power trucks should have, *at least*, the following thickness: For 3½-ton trucks, 10½ in.; for 5-ton trucks, 12½ in.; for 7½-ton trucks, 14 in.; or, if the concrete is reinforced, such dimensions as will give equivalent strength and rigidity. But the use of reinforced concrete in city or town streets, or in surburban highways underlaid with pipes, conduits, etc., where the roadway must be dug into for construction or repair, is of doubtful expediency.

It is apparant that the paved roadway, as usually constructed on rural highways, is much too narrow, especially where the travel is somewhat dense and of mixed character. Without going into details, it may safely be predicted that main highways for the use of such travel should have a paved roadway not less than 20 ft. wide, with macadam shoulders not less than 3 ft. wide on each side. A graded width of at least 35 ft. ought to be provided.

Estimated Cost

How much are highways of the character we are considering likely to cost?

Estimates based upon the present high cost of materials and labor would doubtless be misleading, for there is every reason to believe that prices will recede. They are hardly likely, however, to fall below those of the early years of the war—say in the working season of 1916—for several years, and estimates based on those prices may be considered reasonable. Of course, prices vary in diferent parts of the country. In the estimates presented in the table, the prices of materials and labor are those quoted for Chicago in June, 1916. The cost of the items "grading," and "bridges and culverts," used in the estimates, are the average estimated cost per mile on 25 Federal-aid road projects approved by the Secretary of Agriculture. (See "Year Book of the Department of Agriculture," 1917, pp. 266-9.) These projects are scattered through several states, in and east of the Mississippi Valley, and presumably represent a fair average.

ESTIMATED COST OF ONE MILE OF HIGHWAY DESIGNED FOR THE USE OF FIVE-TON POWER TRUCKS

Paved roadway 20 ft. wide, with 8-in. macadam shoulders 3 ft wide. Plain two-course concrete 12½ in. thick, with bituminous carpet coat

Real estate, right-of-way	$ 50.00
Advertising, printing and legal expenses	100.00
Grading	2,200.00
Bridges and culverts	880.00
Minor drainage	200.00
Concrete base, 1:3:7, 10½ in. thick—3422 cu.yd. at $6.50.	22,243.00
Concrete surface, 1:2:4, 2 in. thick—652 cu.yd. at $8.50.	5,542.00
Bituminous carpet—11,733 sq.yd. at $0.20	2,347.00
Macadam shoulders, 8 in. thick—3520 sq.yd. at $1.00	3,520.00
Forms for concrete	280.00
Engineering and inspection, 4½%	1,677.00
Administration, 2½%	932.00
Sundries	200.00
Total cost per mile	$40,171.00

If the road is designed for the use of 7½-ton trucks, all the items would be practically the same, except the concrete. If the base course is 11 in. and the surface course is 3 in., the increased cost would be about $3000—a total cost of about $43,000 per mile. The substitution, if thought permissible, of reinforced for plain concrete would probably reduce the cost of the concrete items about 15 per cent.

The tendency at the present time seems to be to limit the use of power trucks to the five-ton class, and, if this should be done, we reasonably may expect that roads suitable for their use will cost from $35,000 to $40,000 per mile.

Slope of Ladders and Inclines

In placing ladders, the preferred angle is 75° and the critical or minimum angle 50°, according to information prepared by the safety engineering department of the Workman's Compensation Service Bureau. For ramps or inclines the angles are 15° and 20° respectively, but these apparently relate to ramps for walking and not for wheeling.

Fabricated-Ship Plant Planned for Later General Use

Mobile Shipbuilding Company Forced to Revise Steel Design to Make Use of Timber at Birmingham Shop for Fabricating Ship Material

By M. E. Allen
Assistant General Manager, Birmingham Steel Corporation, Birmingham, Ala.

ONE of the very few fabricating plants in the country, erected and designed primarily for the purpose of producing steel ship material, was recently completed by the Mobile Shipbuilding Co. at Birmingham. The main structural shop was planned for efficient operation in handling material in direct course through the building, from the raw-material yard at one end to the finished-material yard at the other, not only for ship fabrication but for later use in more general fields. After complete designs had been made for a steel mill building type, the War Industries Board refused to allow steel to be used for the buildings, and a combination timber and steel main shop building was designed. The relative costs are given.

During the early summer of 1918, the Mobile Shipbuilding Company, of Mobile, Ala., received a contract from the United States Shipping Board for the construction of twelve 5000-ton steel cargo vessels, a duplicate of a contract which they were at that time executing. Since practically all of the fabricating capacity of the country was then occupied in essential Government work, it was evident that the company would have to provide its own fabricating plant. An arrangement was therefore made with the Emergency Fleet Corporation whereby a fabricating plant could be constructed in Birmingham, Ala., primarily for the purpose of fabricating steel for these vessels.

Plans for this fabricating plant were commenced in August, 1918. It was desired to make provision for supplying the shipyards with fabricated steel at the rate of 4000 tons per month. All of the structures and buildings were designed of steel, and contracts for furnishing and erecting were awarded in September. It was then found that the War Industries Board would not grant a permit for the steel required, on the basis that it was not absolutely essential, and that a timber frame could be used. Accordingly, the structures were all redesigned for the use of timber.

Relative Costs

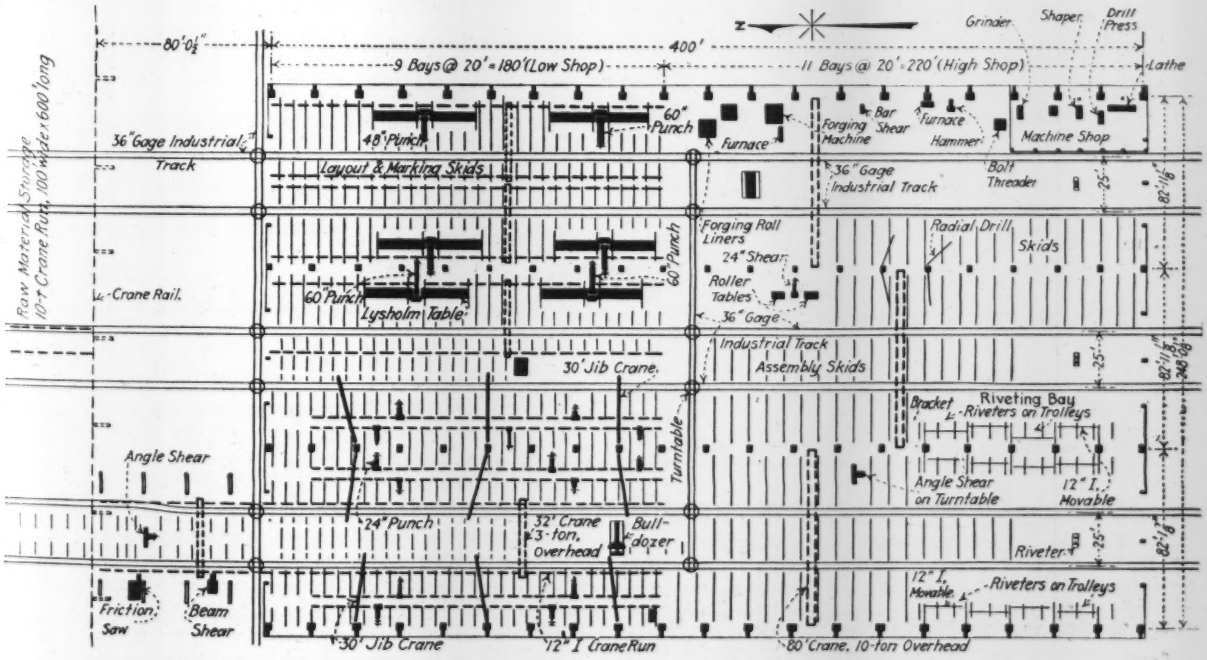
The quantities and cost of the steel frame design of the shop building were as follows:

Estimated total cost, exclusive of equipment, $300,000—including 1680 tons of steel, estimated at $140 per ton erected.

The total cost of $900,000 for the plant, as constructed, is made up as follows:

Structural shop	$215,000
Templet shop	7,000
Brick office building	40,000
Motor generator building	3,000
Machinery and electrical equipment	450,000
Fire protection system	35,000
Yard crane runways	50,000
Plant tracks, grading and miscellaneous items	100,000
Total	900,000

General Layout—At the north end of the main shop building, as illustrated in the ground plan herewith, is a raw-material crane runway 100 ft. wide and 600 ft. long. On the standard-gage track in the center of this yard, 12 to 15 cars of raw material can be stored at one time. Instead of the usual crane-girder bridge, two crane trusses of the Pratt type, 12 ft. apart and 12 ft. deep at the center, with curved upper chords, are used. The five-ton two-motor Shepard electric hoists are operated on the bottom chords, consisting of two 12-in. 20½-



PLAN OF SHOPS, SHOWING ARRANGEMENT OF MACHINERY, TRACKS AND CRANES

lb. channels. The maximum elevating capacity for the two hoists is 10 tons, five tons for each hoist. The plans contemplate two bridges, but at present only one has been installed.

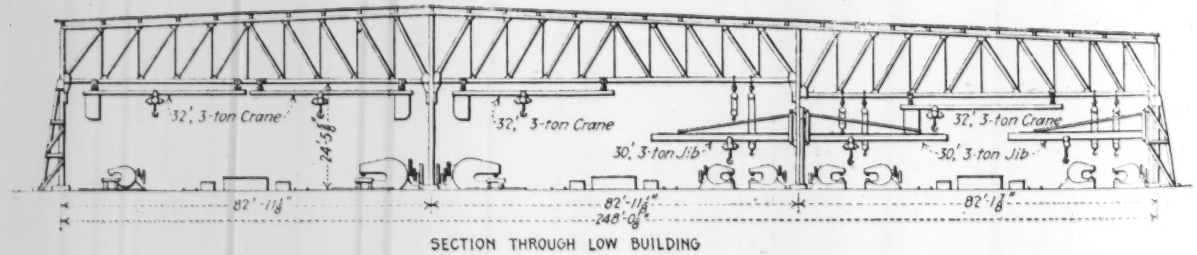
The main shop building, designed as a combination timber and steel structure, approximately 250 ft wide, has three 80-ft. bays 400 ft. long, with an extension 40 x 80 ft. on the north end of the center portion.

VIEW FROM SOUTHWEST CORNER—HIGH-LOW-BAY END OF THE MAIN BUILDING

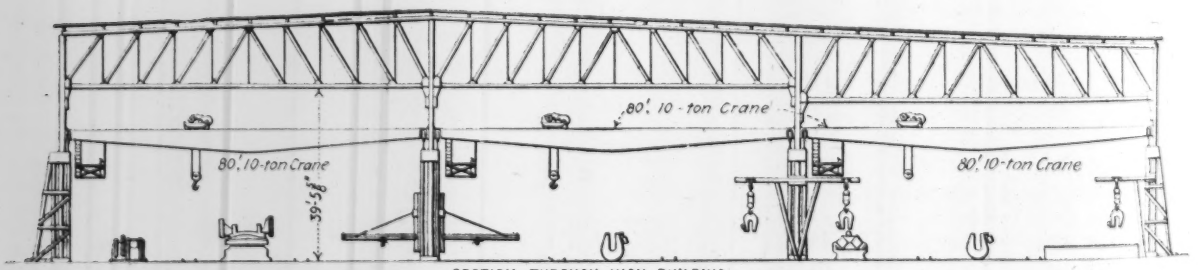
One end is of low-roof construction, and the other of the high-low roof type of construction. The low-roof construction, for a length of 180 ft. at the north end, is built with the lower chord of the roof trusses varying from 21 to 24½ ft. above the floor of the shop. The south end of the building, 220 ft. in length, is from 36 to 40 ft. from the floor to the lower chord of trusses. This difference in height is required, to allow the necessary clearance for cranes to handle large units in the fabricating process. In the high portion of the shop 80-ft. 10-ton eelctric traveling cranes handle the assembled material to the riveters and assembling skids. In the low portion of the building, wnere the punches are placed, it is not expected to handle material over two or three tons as a maximum. Light three-ton traveling cranes serve this portion of the shop, and their travel is limited to the point where the larger 80-ft. cranes operate.

Machinery Layout—Each of the three 80-ft. bays has two industrial tracks 25 ft. apart and approximately 29 ft. from the adjoining columns. These tracks extend outside of the building to the center of the raw-material storage yard and likewise to the center of the finished-material storage yard planned for the future at the south end. There are three rows of turntables to serve the transverse tracks. Only two rows are shown, the other being about 10 ft. south of the south end of the building.

In the west unit of the shop and the west half of the central unit it is planned to fabricate all of the structural work, while the plate work is to be done in the east half of the central unit and the west half of the east unit. The material will be delivered to the layout marking skids either by the industrial tracks or by the 32-ft. traveling cranes, and after being laid out and marked will be handled by the 30-ft. jib cranes on each of which operates a three-ton electric hoist. Jib cranes carry the material from the marking skids to the skids adjacent to the machines, and from these it will be handled by two-ton chain hoists suspended on trolleys from 12-in. I-beams arranged longitudinally over the punches. In the plate shop are five 60-in. punches and one 48-in. punch, each equipped with a Lysholm table and a 32-ft. three-motor electric traveling crane to handle the material from the plate-marking skids to the



SECTION THROUGH LOW BUILDING



SECTION THROUGH HIGH BUILDING

CROSS-SECTIONS THROUGH MAIN BUILDING LOOKING SOUTH—ARRANGEMENT OF CRANES

table and from the table to the industrial tracks or to the high portion of the shop where the shears and countersink drills are placed.

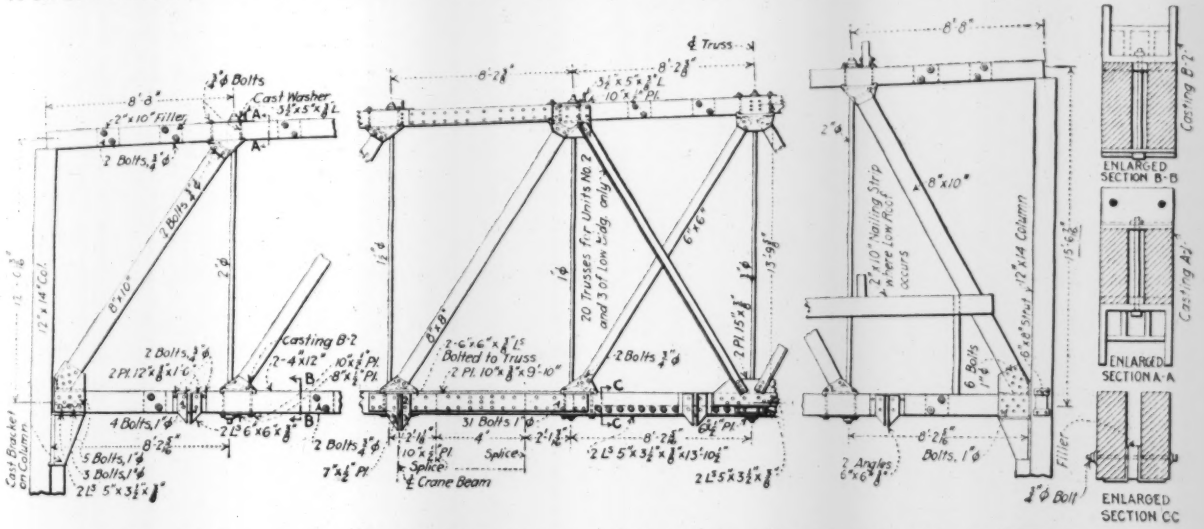
In the southeast portion of the shop, for a width of 30 ft. and a length of 60 ft., are the machine tools necessary for the upkeep of the machines. In the southeast part of the building are blasksmith tools and furnaces. Here 10 x 30-ft. plate furnaces, with a bending floor at each end, are being installed.

Plans for the finished-material storage yard provide for a runway 400 ft. long and 80 ft. wide, served by two 15-ton electric traveling cranes. Of this runway 80 ft. will be placed under cover for the purpose of installing a milling machine and providing space for such work as riveting. The original plans included the design of a structural shop four units in width, and the foundations have already been provided for the fourth unit, although it is doubtful that this will be constructed in the near future.

Planning the Layout—The considerations in the design of this layout, planned to insure the most direct and rapid progress of materials through the shop, were governed by the desire to provide a plant that would not only be particularly adapted to fabrication of ships as its primary purpose, but also to the fabrication of a general line of structural steel for bridges, tanks and framed buildings. With the dual purpose in mind, all tools were placed on heavy timber foundations to permit moving at no great expense if change in character of work warranted rearranging the tools.

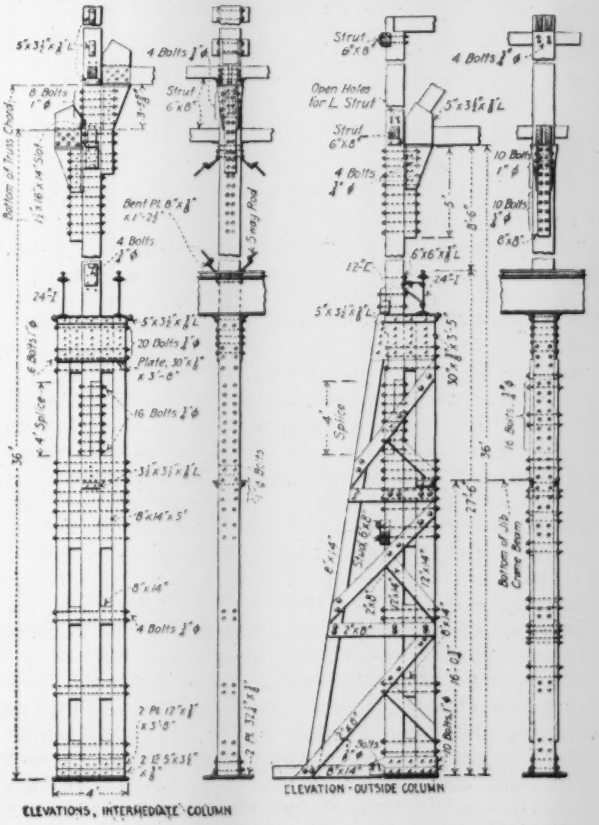
While the large shop building was laid out under one roof, the plate department and angle shop are so separated that either one can be operated economically with the other side closed down. All materials moving into the shop from the raw-storage yard successively pass the saw or shears to the markers, then go to the punchmen and on to the assembly end of the various units, where such operations as reaming, countersinking, burning or welding, chipping and riveting, are executed, after which the finished piece is submitted for final inspection before passing out to finished storage for loading.

The templet shop is located just west of the structural shop and is 60 x 128 ft. in plan. At present the southeast corner is used for a general store room. In this templet shop a full line of woodworking tools is provided, although present arrangements do not include a mold-loft floor, inasmuch as the bow and stern sections of the ship are fabricated at the shipyard.



TYPICAL DETAILS OF ROOF TRUSSES IN MAIN BUILDING—STEEL SPLICE PLATES FOR LOWER CHORD

Fuel-Oil System—Oil is used exclusively for heating rivets and in forming plates, shapes, etc. Suitable furnaces are installed for these purposes in the various units. The oil-storage system includes three second-hand tank cars, each of 4500-gal. capacity, placed in a



TYPICAL DETAILS OF COLUMN SPLICES AND BRACKET CONNECTIONS

concrete pit at the southeast corner of the site at such an elevation that a standard tank car on the adjacent siding can drain into them by gravity, and connected to the discharging tank by means of a swivel joint so that any tank or combination of tanks can be filled or emptied.

Adjacent to the tank pit is the oil pump house, the floor of which is at such an elevation that the oil flows by gravity from the storage tanks to the pumps after passing through a twin strainer. The distribution system is composed of 3-, 2- and 1-in. standard black pipe equipped with suitable valves and fittings, all pipe being laid to grade so that it will drain to a sump located at the pump house.

Three fire ladders on each side of the main shop buildings are provided. They are of heavy, permanent construction, trussed into the building at various points, and are planned in connection with the fire protection system to afford immediate access to the roof in case of fire. A 75,000-gal. steel tank on a 100-ft. tower is also a part of the fire protection system. A complete line of 6- and 8-in. mains completely surrounds the main shop building and templet shop, with hydrant hoses about 50 ft. from the building and not over 150 ft. apart. Chemical fire extinguishers are also placed throughout the shop building and the templet shop. A plant fire marshal directs fire drills at regular intervals.

The design of the various structures and machinery layout was under the supervision of G. S. Bergendahl, chief engineer of the Birmingham Steel Corporation, and his assistant, W. V. Bickelhaupt. The writer, now in charge of plant operation, was in charge of the construction and worked closely with the engineering department. H. L. Brittain and Frank McLoughlin are respectively president and general manager of the Birmingham Steel Corporation, and hold similar offices in the Mobile Shipbuilding Co., Terry Shipbuilding Co., and other Southern dock and repair companies.

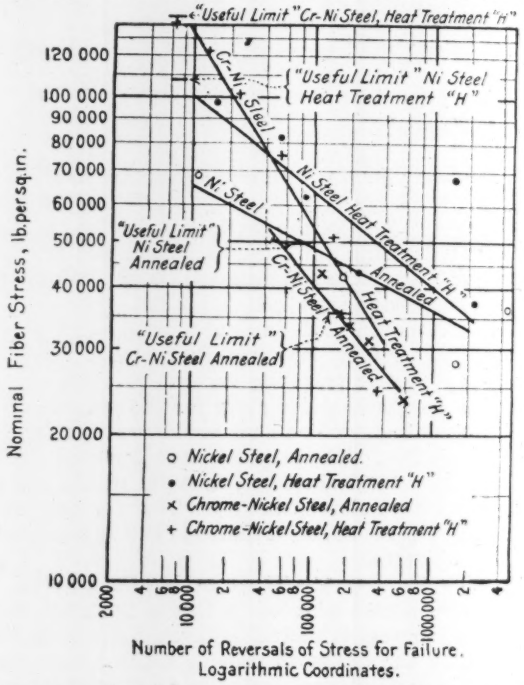
City Consulting Engineer and Works Director

Having decided to carry out a large program of public improvements, the City of Monroe, La., has engaged an engineer who will serve with the title of consulting engineer and director of public works. The appointee is Walter G. Kirkpatrick, who was at one time city engineer of Birmingham, Ala. In 1916 Mr. Kirkpatrick reported on the municipal needs of Monroe. A program of improvements was laid out, but local differences and the war resulted in postponement of action. Recently the commission form of government has been adopted at Monroe, and natural gas has been developed with the promise of the opening up of an oil field nearby. The commission has engaged Mr. Kirkpatrick for the four years' life of its administration, at a salary of $10,000 a year. He is expected to design and supervise the construction of some $2,000,000 worth of public improvements, including new water-works with a filtration plant, a new drainage system, enlargement and improvement of the sewerage system, improved means of waste disposal, a new electric lighting and power station, and improvements in the municipally owned street railway, besides a municipal wharf and elevator and other construction. Apparently most of this program will not be emptied, but will go over into the year 1920.

Comparative Endurance of Chrome-Nickel and Nickel Steels

ALTERNATING stress tests of nickel steel and chrome-nickel steel made at the University of Illinois show that nickel steel has higher endurance qualities, although tests were made at high stress and therefore had a relatively small number of alternations, which would indicate the chrome-nickel steel to have the greater resistance to fatigue. It also appears that hardening and tempering do not improve the fatigue-resisting properties of the metal, but rather have the opposite effect. Both these conclusions, however, are made entirely on the hypothesis of the experimental law connecting stress and number of repetitions or alternations required for failure; in other words, the law under which the logarithmic plot of repetitions and stress would be a straight line.

The report of these tests was presented by H. F. Moore and A. G. Gehrig before the American Society



EFFECT OF REVERSAL OF STRESS ON NICKEL-STEEL

for Testing Materials, in a paper entitled "Some Fatigue Tests of Nickel Steel and Chrome-Nickel Steel." The logarithmic plotting method is used as the basis for all the conclusions drawn, although the experimental points are scattered on both sides of the arbitrarily drawn lines. A typical diagram from the paper is reproduced herewith. It shows the lines for chrome-nickel steel, sloping more steeply than those for nickel steel, and therefore indicating earlier failure under relatively low fiber stresses. The authors say, however, that these test results should not be interpreted to mean that chrome-nickel steel is in general inferior in fatigue resistance to nickel steel. The lines drawn for the heat-treated specimens are of deeper slope, also, than those for the annealed specimens, indicating, according to the author's interpretations, a lower ultimate fatigue strength for the heat-treated specimens than for those not heat-treated. Quoting from their report, "the heat

treatment added but little to the fatigue resistance under repeated reversals at low stress."

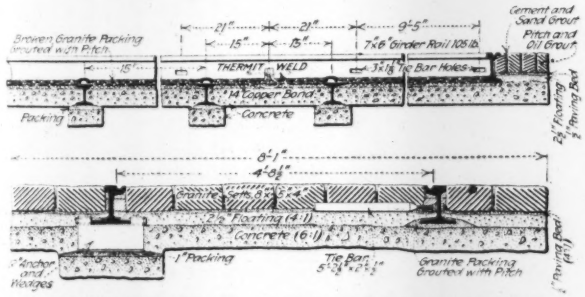
Very decided flattening of the slope of the curves was produced by polishing certain specimens. Comparison with the results obtained for specimens treated in exactly the same way but not polished show a large increase in the resistance to alternating stress, produced by the polishing. Because of the flatter slope of the curve "the superiority in fatigue resistance of the polished specimens over unpolished specimens increases as lower test stresses are used."

Latest British Street-Railway Track Construction

Ties Generally Omitted—Bituminous Granite Chip Packing Under Rails Used—Thermit Welding and Rail Hardening in Place

EXCEPT on high-speed lines or over very poor subsoil, it is not the general practice to use cross-ties in street-railway construction in Great Britain, according to an article in the *Electric Railway Journal* of Apr. 12, 1919. At Leeds only a bituminous granite-chip packing is placed between the rails and the concrete sub-base. Welding the rail points with thermit, hardening the top of the rails in place by the Sandberg "sorbitic" process, and the use of a special rail section, are also practiced at Leeds. The construction shown is that put down by R. Bickerstaffe Holt, who was, until March, highway and permanent way engineer of Leeds and is now a member of the staff of C. P. Sandberg, consulting engineer, London. The following is an abstract of the article describing the design used by Mr. Holt, who is author of "Tramway Track Construction and Maintenance" and a recognized authority on the subject.

Standard street-railway track construction in Great Britain, of which that at Leeds is typical, is radically different from anything used in the United States and



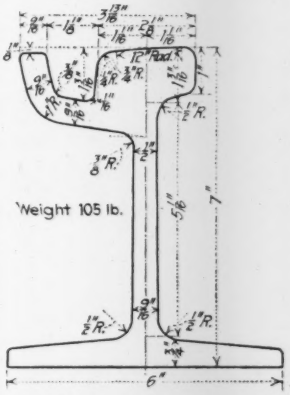
STANDARD TRACK CONSTRUCTION IN LEEDS

Canada. The accompanying cut shows the construction as adopted by Mr. Holt. The concrete sub-base is 6 in. thick, and the mix shown as 6 : 1 corresponds to our 1 : 2 : 4 mixture. The rails are held to gage with tie-rods, and except at anchorages, which are spaced ordinarily on 15-ft. centers and 10 ft. on high-speed lines, the rails are supported only by a granite packing grouted with pitch or some patented compound like "Fibrastic" in which they are embedded. This packing is placed only adjacent to the rail, while over the entire bed, between the concrete base and the paving bed, there is placed a moist 1 : 4 mixture of sand and cement. The paving bed is of the same mixture. When this has set it tends to prevent entrance of water.

In this connection, Mr. Holt points out in his book, mentioned above, that "it is a mistake to suppose that a sand paving bed affords any advantage in the nature of a cushion beneath the paving, after the paving blocks have been rammed; the bed is perfectly hard and unyielding, and in any case it is undesirable to have a resilient cushion between the blocks and the foundation." This is interesting in that it agrees with all kinds of block-laying experience in the United States.

Occasionally, cross-tie construction with the ties on 3½-ft. centers, embedded in concrete and with pitch granite packing under the rails between ties, is used on high-speed lines and in places where clayey soil is encountered. Otherwise, very little tie construction is used. The only advantage of ties other than anchoring the rails is their resiliency in absorbing vibration. This, however, is thought to be lost if the rails rest upon a rigid foundation in any of their lengths. On such a track in Leeds it was necessary to replace the rigid material under the rails with the pitch-granite packing after the track had been used for a time.

Thermit welding is employed at Leeds, but Mr. Holt states that it is unfair to expect perfection when the rail profiles are designed for fish-plate joints, and the web is too thin to withstand molten metal without likelihood of damage. He has designed a new rail section, shown in the illustration, which is 7 in. high and weighs 105 lb. to the yard. Its web is $\frac{1}{16}$-in. thicker than the web of the British standard rail of equal weight and is directly beneath the center of the rail tread. The tread is convex and is inclined toward the groove, the convexity and inclination being arrived at as a result of hundreds of gagings of partly worn rail and wheel-tire sections. This tread section corresponds to that adopted by the Brooklyn Rapid Transit Co. in 1915, although the reason for wanting a cone tread was not the same in the two cases. In the latter case the change was to insure longer life and better traction without reference to any one factor of destruction. More than 7000 English tons of this section have been laid at Leeds since January, 1910, and no extrusion of metal has been observed to date, although as many as 2,000,000 cars, averaging 11 English tons each empty and 15 tons loaded, have passed over one route so equipped.



SPECIAL RAIL SECTION USED IN LEEDS

The Leeds system is one of the first users of the Sandberg "sorbitic" process of hardening the head of the rail in place. More than 250,000 cars have run over one section hardened in this manner in two years, yet Mr. Holt has found no evidence of wear. Better still, the incipient corrugations in the rail at the time the hardening process was applied have since disappeared. Hardening need not extend to a depth greater than $\frac{3}{16}$ in. It is not comparable exactly with case-hardening, as one molecular granulation blends into the next, instead of presenting a line of cleavage.

Union Station is Rebuilt Without Interrupting Traffic

Elevated Trainshed Erected and Tracks Raised and Rearranged at Indianapolis While Carrying 165 Trains Daily—Steel Structure Has Concrete Deck and Roof With High Skylights

STATION reconstruction and track elevation in consecutive parallel sections is the method employed in rebuilding the union station in Indianapolis, Ind., so that trains are operated at both the old and new levels during the progress of the work. This is the most important part of the general scheme of track elevation in the city. Its execution was a difficult problem, as the entire passenger traffic of the numerous railways passes over the connecting link formed by the Indianapolis Union Ry., on which the union station is situated. This traffic averages 165 passenger trains daily, arriving and departing, of which 70 are through trains. In addition, about 60 freight movements are made on two tracks assigned for this traffic, which is mainly for industry service.

The track layout had to be enlarged and rebuilt at the new elevation, and the old trainshed replaced with a new structure having the tracks and trainshed on the upper deck. All this had to be done with practically no interruption to the heavy traffic, or interference with the numerous switching movements incidental to terminal operation.

An important advantage rested in the fact that the station was to be widened on the south side, so that the new work could be done on this addition before beginning to interfere with the old station. Thus, the boundary retaining wall, the ends of abutments at cross streets, the baggage tunnel and the pedestal footings for the columns, were built on this section in advance of any extensive work on the existing tracks. The superstructure was erected and the track deck laid for this section, the new tracks being then connected with the main track approaches at each end, so that it was possible to operate trains on this piece of elevated structure, the platforms being temporarily without shelters.

Four elevated station tracks were thus completed and put in service during the summer of 1918. This enabled the adjacent four tracks in the old station to be abandoned for the construction of another four-track elevated section, which was completed in the spring of 1919. The work will be carried on in this way, by the successive abandonment of surface tracks and widening of the elevated structure. After this is completed, the erection of the trainshed roof will be undertaken.

The new station is a double-deck steel frame structure having the track deck about 15 ft. above the first floor, this deck having concrete platforms and track floor. Most of the space on the first floor will be utilized for station facilities. Across it will extend a concourse or corridor 100 ft. wide, opening from the old concourse parallel with the trainshed but having no outlet at the south end. Stairways transverse to the tracks will lead up from the center of this corridor and branch in both directions to the platforms. Concrete ramps having a grade of 16% were provided in the original design, but stairways were substituted, on account of the length of ramp required for the limiting grade. Most of the space east of the lateral concourse will be utilized for the baggage room. On the west side of the concourse will be shops fronting on Illinois St., which passes under the middle of the elevated trainshed; beyond this street will be the mail and express rooms.

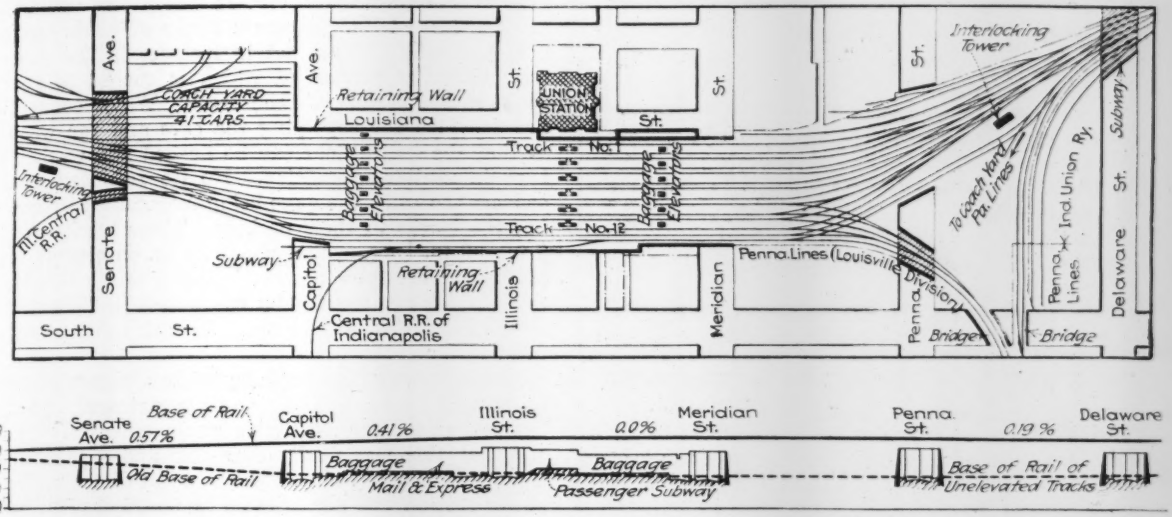
A baggage-transfer tunnel 630 ft. long, connecting the ends of the station, is made necessary by the traffic conditions. As trains headed in either direction may occupy any station track, baggage elevators must be provided at both ends of the platforms. Those at the east end are directly adjacent to the baggage room, while those at the west end are served by a transverse passage at the street level. To provide for the movement of baggage trucks between the elevators and the baggage room, a low level subway or tunnel was built

RECONSTRUCTION OF UNION STATION IN INDIANAPOLIS, IND.

under the south side of the station, passing under Illinois St. This tunnel is 18 ft. wide and 10 ft. high, and has inclined approaches at both ends, starting at the ground level and near the elevators. Tractors and trailers will handle the baggage, mail and express.

transmitting these loads to the soil through the bottom slab acting as an inverted beam. The load on the base of the footings is limited to 2½ tons per square foot.

Retaining walls and abutments are of plain concrete, of gravity section, with footings built directly upon the



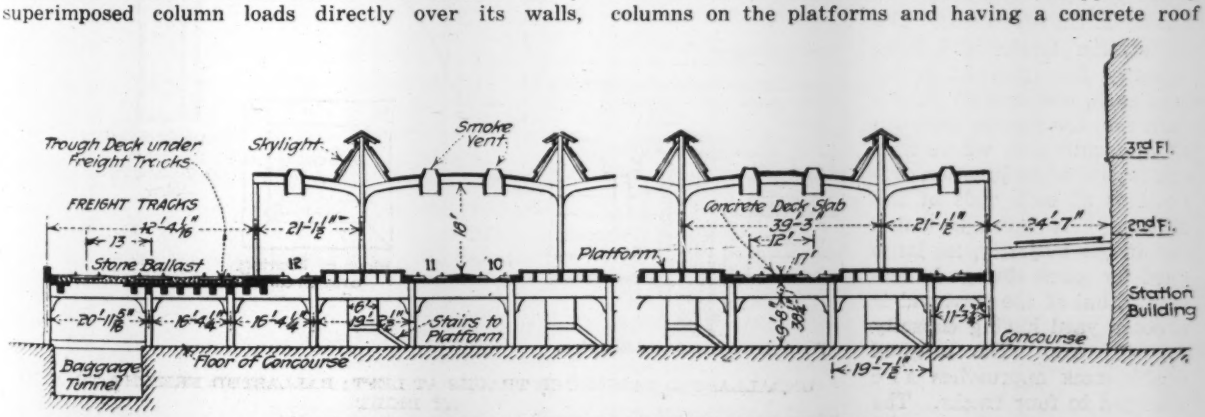
TRACK LAYOUT OF INDIANAPOLIS UNION STATION AND ITS CONNECTIONS

Ticket offices, waiting rooms, dining rooms and other passenger facilities, as well as the railway offices, will remain in the old station building at the north side of the tracks. This is a handsome red brick structure with a main hall 48 x 148 ft., and has ample accommodations, some changes in the interior arrangement having been made a few years ago. The present concourse at the street level, parallel with the tracks, will also remain. Architectural treatment of the fronts of the new elevated structure will mask the trainshed roof with its high skylight and will include decorative entrances to the street-level subway carrying Illinois St. under the trainshed.

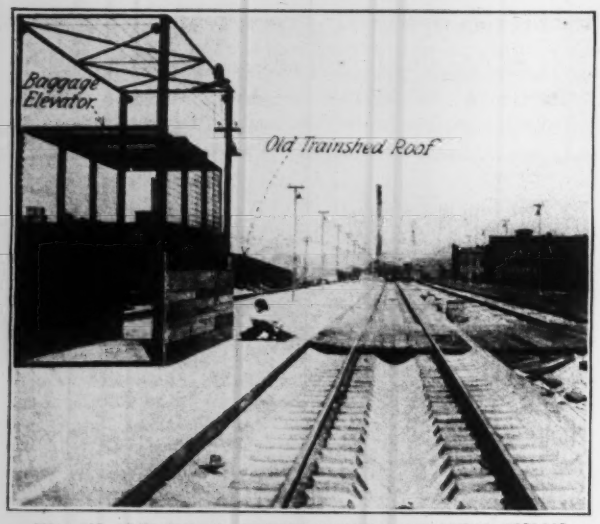
Foundations involved complicated design in several instances, owing to underpinning, limited clearance or other structural requirements. Conditions are favorable, however, as the site is on a deep gravel formation, the material of which is practically incompressible. Plain concrete footings are used principally, but some of those for pipe tunnels and subways are 25 ft. below the surface. The baggage-transfer tunnel is of heavy reinforced-concrete construction and carries heavy superimposed column loads directly over its walls, gravel, and the walls having expansion joints at intervals of 30 ft. A bituminous waterproofing coat is applied to the rear, and against this is a backing of dry stone piers which permit drainage or seepage water in the fill to reach tile drains with sewer connections. The south wall, along the right-of-way, is carried up to form a high parapet.

Columns on the first floor support lines of transverse girders, and under the passenger tracks these carry a deck of transverse, shallow troughs built up of Z-bars and plates. For the freight tracks the deck is of deep, longitudinal troughs, between the girders. In both cases the troughs are filled with concrete which forms the deck slab. The platforms are supported at the edges by longitudinal girders along the sides of the Z-bar-trough sections and have intermediate beams resting on the cross-girders.

An unusual amount of skylight area is provided in the trainshed roof, which will be of the low type now generally used at large stations, but having high triangular monitors with skylights over the platforms. It will be of steel-frame construction, supported by columns on the platforms and having a concrete roof



PART CROSS-SECTION THROUGH NEW STATION TRAINSHED



TRACK AND DECK CONSTRUCTION OF NEW UNION STATION IN INDIANAPOLIS

slab with longitudinal openings over the tracks to permit the direct escape of smoke and steam from the locomotives. This roof will be about 930 x 240 ft., with columns spaced longitudinally from 50½ to 63 ft. Over the main low-level concourse running parallel with the trainshed will be an arched skylight roof supported by I-beams extending from the trainshed structure to the station building.

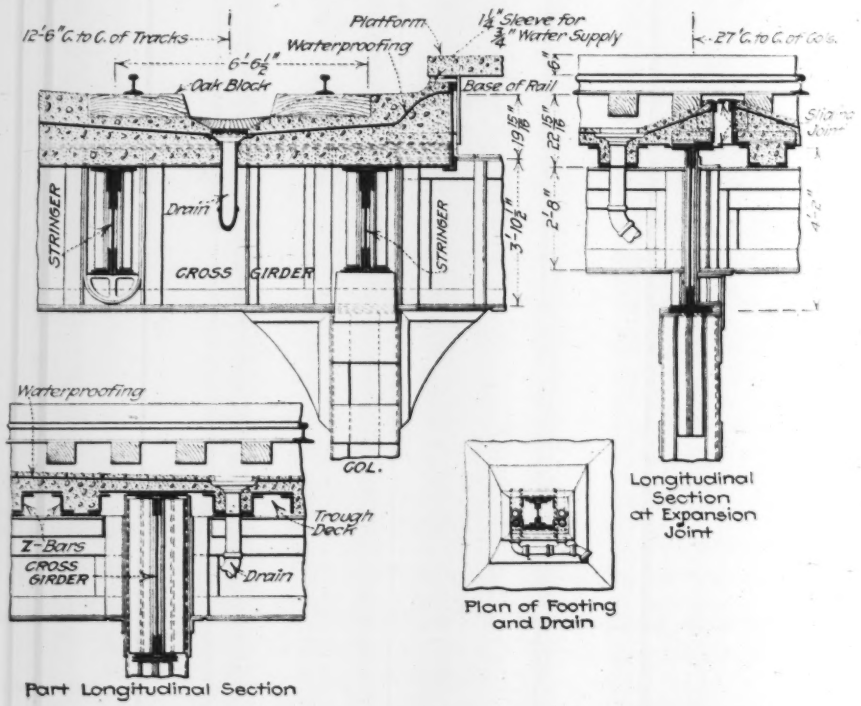
The old steel trainshed, shown in one of the views, was built in 1888 and was of the obsolete lofty-arched type. Steel columns supported trusses of 102 ft. and 68 ft. span with curved bottom chords and having 15-ft. cantilever extensions on the south side. Its length was 703½ ft. and the trusses were spaced from 25 ft. 10 in. to 45 ft. on centers. A glass screen closed each end of the roof and a monitor along the ridge provided ventilation. In spite of the frequent painting of the trusses they had become badly corroded.

In the new station there will be 12 through passenger tracks and a stub track at the west end for baggage, mail and express cars. There will be also three freight tracks on the south side. The 12 station tracks will have capacity for from 12 to 23 cars each, allowing 80 ft. for each car; the shorter ones are at the south side, where they are restricted by junction connections at both ends of the station. As through trains are in the majority, no large yard for coach storage is necessary, but at the west end is a coach yard having capacity for 41 cars. The original double-track approaches are enlarged to four tracks. The old station had eight through tracks in the trainshed, with a short stub track at the east end and two outside tracks for freight, switching and transfer movements.

Track construction for the passenger tracks in the trainshed is similar to that employed for some tunnels and large terminal stations, in which ties and ballast are dispensed with. Separate blocks of white oak support the rails and are set in recesses in the concrete deck slab, the surface of which is shaped to form a drain in the middle of each track. Water connections are provided for supplying the cars and for washing, so that the entire floor can be flushed and washed and kept in sanitary condition. No tie rods are used to connect the rails, the gage being maintained by anchoring the blocks in their pockets. These blocks are 7 x 9 in., 36 in. long, spaced about 22 in. on centers longitudinally. On them are steel tie-plates for the 100-lb. rails, which are secured by screw spikes. The freight tracks have ties laid in stone ballast on the concrete deck.

Development of the track layout has been progressing for several years. Difficulty was experienced in acquiring real estate for a suitable arrangement at the east end, but this was finally overcome and a satisfactory layout made practicable. The removal of the railroad's power station was necessitated by the final plan, but no new power station will be built at present, as electric current and steam will be purchased from the Indianapolis Electric Light & Heat Company.

Two junctions close to the station complicate the track layout. One is for the Illinois Central R.R. at the west end, having 14° curves; the other is for the Louisville division of the Pennsylvania Lines at the east end, with 12° curves. There is a junction curve of 16° at the middle of the station, but this is on the freight tracks only, and is for the industry line known as the Central



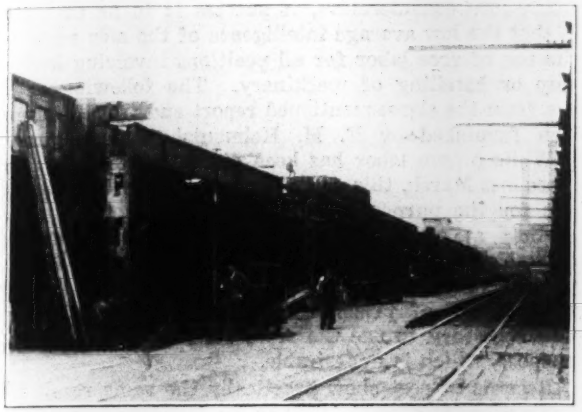
UNBALLASTED PASSENGER TRACKS AT LEFT; BALLASTED FREIGHT TRACKS AT RIGHT

Note water connection and drain

R.R. of Indianapolis, which serves several industries.

Slip switches are used rather sparingly in relation to the extent of the layout, there being eight at the east end and 15 at the west end. All these are double slip switches. The Illinois Central R.R. connection includes slip switches giving access to three station tracks, but the Pennsylvania Lines connection at the southeast corner gives access to four tracks by plain turnouts. Turnouts are mainly No. 8, with 16½-ft. switch rails. Three interlocking towers will control train movements.

All plans are passed upon by a board of engineers composed of W. C. Cushing, chief engineer of maintenance of way, Pennsylvania Lines; C. A. Paquette, chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry., and P. J. Landers, superintendent (and formerly engineer) of the Indianapolis Union Ry. Construction work is in charge of T. R. Ratcliffe, engineer of maintenance of way. Price & McLanahan, Philadelphia, prepared the plans for the architectural designs at the station. The McClintic-Marshall Co. and the Mount Vernon Bridge Co. are the contractors for the structural steel work, while the latter company and Powers & Addy have the contracts for its erection. Latham & Walters have the contract for the concrete roof and architectural work and the Marion County Construction Co. has that for concrete foundations, retaining walls and abutments. Filling and track work are done by railway forces.



NEW ELEVATED STRUCTURE REPLACING OLD SURFACE TRACKS THROUGH STATION (MAY, 1919)

Long Road Contracts in Arkansas

Proof of the advantages of letting highway construction contracts in long sections is afforded by experience in Arkansas, giving a practical indorsement to the suggestions along this line made in *Engineering News-Record* of Mar. 13, 1919, p. 503, and Apr. 24, 1919, p. 831. A firm of engineers having considerable road work in that state makes a practice of letting single contracts for 20 to 30 miles of road, and reports that in this way the larger contracting concerns are interested, while with short sections there would be numerous local contractors, without competition from firms perhaps better equipped to execute the work. The work is divided into sections, but as a rule a contractor will bid on the whole work at a cheaper price. In some cases there are no bidders for separate sections, while several bids are made for the entire mileage to be let.

Membership and Functions of Local Engineering Associations

C. W. Hunt, Secretary of the American Society of Civil Engineers, Outlines His Suggestions for Development Committee

ADDRESSING the Development Committee of the American Society of Civil Engineers at its Minneapolis meeting on June 13, Dr. Charles Warren Hunt, indicated his point of view after 27 years' service as secretary of this society by quoting letters written by John W. Alvord, and then proceeded to outline his suggestions regarding the details of membership qualifications and proper functions for local engineering associations. The details of these suggestions follow:

If I am not very much mistaken the original idea of the Development Committee of the American Society of Civil Engineers was the development of the Society itself to meet existing and changed conditions due to the war, etc., and that to its duties was added later the question of co-operation with other bodies for the general good.

I have not been asked, as I understand it, to come here with any suggestion as to improvement in methods of the Society's work, nor do I know to what extent the Committee has decided on suggesting fundamental changes, but I believe that it is entirely proper for me to discuss that part of the problem which relates to the co-operation between organizations, inasmuch as that has nothing whatever to do with the management of the American Society of Civil Engineers. I have therefore ventured to write out, as briefly as possible, a statement of my views, based upon a great deal of careful thought and considerable knowledge of conditions both at headquarters and in various parts of the country.

There are in my judgment two entirely separate phases of the general subject of the condition of the Engineering Profession.

(1) The theoretical, scientific, educational side, which includes the maintenance of high professional and ethical standards, and

(2) The welfare side, which includes all matters relating to the Profession outside of those in No. 1. This means not only the participation of the Engineer in civic and community affairs, but concerted action connected with National, State and Municipal problems, in which the welfare of the members of the Profession both individually and collectively is concerned, such as professional rates of pay, employment of engineers, and all legislation which affects the Profession either locally or nationally.

In my opinion, these two lines of effort cannot be carried on together. The National Engineering Societies are well organized for, and can carry on, the first of these, and they should not be interfered with nor hampered by being forced to undertake the second.

If this be true, then the problem is to so organize the Engineers of the country that they may be able to handle both national and local matters concerning the welfare of the Profession. My experience is that the chief difficulty in the attempts which have been made up to the present time in co-operation among various groups of Engineers is that we have been trying to work from the top down and not from the bottom up. I think that true co-operation must have its source in the individual, or in smaller geographical groups of individuals, which groups shall elect their representatives and instruct them as to the lines on which they wish co-operative effort made. They must also finance that effort in proportion to the numerical strength of each sectional or geographical group.

At present, boards of Engineers elected for the specific purpose of managing an individual organization—and for that purpose only—are transferring certain powers which have been given them—and perhaps a number of others which they have never possessed—to another group of their own appointees. Apart from the question of whether they

have the constitutional right to transfer powers granted them by their constituents, the result is not satisfactory. A man so appointed is not really responsible to anyone—he has no constituents or electors to whom he must report and whatever action he may take on any matter must therefore be entirely dependent on his personal views.

I believe that the Engineers of the country can be organized by forming a truly representative body which might be called "Engineering Council," for want of a better name. The first difficulty which to my mind presents itself is that at present there is no method of determining who may, or who may not, be properly classed as Engineers except by the assumption that all men who have been admitted to a national organization can qualify. With this brief statement I would suggest:

That through the co-operation of the Development Committees of the four National Societies a plan be developed along the following lines:

That in each center of population there be formed a local Engineering Association to be known by the name of the city or by some other distinctive sectional name.

That the voting membership of each of these associations be limited to the membership in any grade of any National Society of Engineers residing in the territory covered by the association. It will be observed that this is not intended to restrict the membership to the four Founder Societies only. That Engineers in the territory who are not connected with any of the National Societies be admitted as "Associates" or "Affiliates," until such time as they become connected with the national organization representing their specialty.

These associations would have two functions, viz:

(1) To act upon all local matters whethers Municipal or State (the latter in connection with similar associations).

(2) To elect directly in proportion to its numerical strength, or, if not large enough, in connection with its neighboring associations, its proportionate representation on a National "Engineering Council," and to contribute in similar proportion to the support of that Council.

The advantages of such associations would apparently be: Added numerical strength in each locality; local recognition of the fact that all members are Professional Engineers—in other words, something definite as to who is and who is not an Engineer—and direct touch through properly elected representatives, responsible to and reporting back to their constituents all actions of the "National Council." In addition to this each would be, so far as local matters are concerned, not responsible to any National Technical Society, which condition at the present time is a more or less troublesome one, for we all know that the question of the relation of the present "Local" association or section both to the parent organization and to similar locals has been, and still is, subject to much debate. In one case at least a parent National Society found it necessary to repudiate action taken by one of its local chapters.

In addition to the representatives elected in accordance with the above each National Technical Society should be authorized to appoint one or more members of the "National Council." These appointees would be the logical representatives of the very large membership in these societies which is not connected with any local association.

If this plan were considered feasible and developed by our Committees in connection with the Development Committees of other Societies, on the present basis of membership of the four Founder Societies alone there would be a general Local Engineering Association of approximately 6600 members in New York City, and in San Francisco it is estimated that there might be more than 800.

Nothing that I have suggested above would interfere with the maintenance of the present Local Associations or Chapters of the Founder Societies, but they would be relieved of the necessity of acting on matters which are not strictly those which belong to the parent Society. In other words, they would act only on matters which affect the policy of the National Societies of which they are Local Chapters.

Convict Labor as Utilized on Arizona Highways

Men Have Low Average Intelligence and Need Special Handling—Free Men Better for Machine Operators and Foremen

STATE convict labor can be employed on highway construction with success and economy, subject to certain important qualifications and conditions, according to the 1916-18 biennial report of B. M. Atwood, former state engineer of Arizona. This opinion is based on nine years of experience of the State Highway Department. One of the principal conditions that must be taken into consideration, if success is to be obtained, is that the low average intelligence of the men requires the use of free labor for all positions involving leadership or handling of machinery. The following notes are from the above-mentioned report and from information furnished by F. M. Holmquist, state engineer.

While prison labor has been discontinued in Arizona since last March, this was not on account of inefficiency, but for the purpose of giving preference to returned soldiers, sailors and marines. There is ample free labor available to take care of all road work in sight for the present year. Furthermore, the appropriation for the maintenance of prison camps was exhausted, and it was necessary to use the state road tax fund for this purpose, which is undesirable.

Records of cost show practically the same result for work done by convict labor as by free labor, according to Mr. Holmquist. As the distance of the camps from the prison was about 400 miles by rail there was considerable expense involved in transporting the prisoners and guards. It is intended, therefore, that when the use of convict labor is resumed it will be employed nearer the prison in order to avoid this expense.

Mr. Atwood reports that convict labor has been employed on heavy mountain work and light grading, on the construction of reinforced-concrete bridges and culverts and in the production of crushed stone, concrete pipe and other road materials. Experience during the nine-year period has been varied. At times the labor has been expensive and inefficient, with poor discipline and with a large percentage of the men in camp idle and under disciplinary detention. At such times the percentage of escapes was apt to be high. On the other hand, much of the convict work was satisfactory, with low cost, high efficiency, good feeling and healthy conditions among the men.

Importance of Leadership

The general conclusion arrived at is that convict labor is capable of producing work of good quality in highway and bridge construction with low costs and few escapes, while the camps may be so managed as to benefit the men physically, mentally and morally. Such labor, as stated above, is more dependent upon the quality of its leadership than is free labor, and it is suggested that where good results are not achieved the responsibility should be laid on the personnel and methods of the management, rather than on the quality of labor employed. This statement is not intended as a criticism of anyone who may fail to make a success of the prison camps, for it is recognized that dealing with prison labor requires somewhat different qualities from those for dealing with free labor.

In the Arizona convict camps there were usually 40 to 55 men, but sometimes as many as 90 to 100. The rising time was 6 a. m., and promptly after breakfast the men boarded motor trucks, leaving camp in time to start work at 8 a. m. Each gang was in charge of a foreman, assisted by armed guards. Dinner was brought out on the trucks, unless the men were near the camps. The working day was limited to eight hours, which is the legal time for free labor in Arizona. The retiring time was 9 p.m. Either bunk-houses or large tents were provided, and were surrounded by a high barbed wire fence. A barber shop, a concrete toilet and a shower bath were included in the equipment of each stockade, and absolute cleanliness was insisted upon. Feeding the men is discussed in an article in *Engineering News-Record*, of May 22, 1919, p. 1032

Taking the men away from the state prison and keeping them actively employed in open-air work has been found to improve their physical and mental tone, but it is important to keep them constantly employed, either at work or in some healthful recreation. The importance of this is so great that when recreation cannot be furnished the men should be assigned to different forms of work on different days, in order to avoid monotony in their employment. In fact, it is considered better to insist on long hours of work rather than to allow idleness without proper amusement.

Provision for some reward for the men who do their work satisfactorily is another important point, and the reward should be such as to show clearly that these men benefit more than those who fail to render the service and obedience demanded. It may be in the form of scrip that can be exchanged for fruit or candy at the commissary, or a reduction in the term of imprisonment, or perhaps in money to be held in trust for the benefit of the convict or his dependents. In Arizona, the superintendent or engineer in charge of the prison camp sent to the state engineer each month a report recomemnding men for parole or commutation of sentence. The state engineer in turn made his recommendation to the Governor and the parole board.

As advice to those contemplating the use of prison labor, the report urges a visit to some properly conducted convict camp.

Recording Strain-Gage to Measure Stresses in Ships

AN INSTRUMENT to measure and record the strain in various parts of ships under actual loading conditions was devised by the concrete ship section of the Emergency Fleet Corporation during the war. It was described by F. R. McMillan, who had charge of its development, in a paper entitled "The Strainagraph and Its Application to Concrete Ships," presented to the American Concrete Institute meeting. Mr. McMillan's paper included a brief description of the instrument and the story of its development, together with an illustration of its use in determining the stresses in the concrete ship "Atlantus" during its launching at Brunswick, Ga., last autumn. The instrument comprises a revolving paper roll on which, by the multiplication of a series of levers, is recorded the movement between two points on the piece whose deformation is being measured. In its operation on ships two gage points are established at critical places in the ship's frame and hull, and the extending lever of an instrument is fastened to each pair of points. The lever is connected to the recording instrument, which is a development of a recording pressure instrument of the American Steam Gage & Valve Manufacturing Co. designed for studying the air-brake control of trains. Each instrument is motor-driven and they are all tied together by an electric circuit so that synchronous records can be assured. In the investigations on concrete ships there were also installed pressure-recording gages, so that, synchronously with the strain measurements, there could be ascertained the height of the waves outside the ship.

The launching tests on the "Atlantus" give a complete record of the height of water on the ship side as it went into the water, and the flow of the stresses during the launching process. The paper further includes three curves of stresses measured by the instrument and calculated previous to the launching of the ship which show a remarkable agreement of results.

Overhead and Time Cost of Pit and Trench Excavation

Ten Per Cent. in Excess of Direct Cost for Extra Work Does Not Equal Overhead Costs on Simple Excavation

By A. P. Roscoe
Ozone Park, New York

EXCAVATIONS required 3¼ man-hours per cubic yard as an average in making 436 pits for elevated-railway column footings built in the years 1915 to 1917 in New York City. All the pits were dry. On another group of 24 pits, for which 46% of the excavation was below water level, the labor required was 11.03 hours per cubic yard. Trench excavation required 4.11 hours of labor per cubic yard. The overhead cost on both jobs was nearly one-fifth of the total cost and almost a quarter of the labor and materials cost. In all cases the work included sheeting and excavating, backfilling after the structure was constructed, and hauling away the surplus material. The costs were computed from daily reports made by inspectors.

The pits were located 26 ft. apart transversely and 50 ft. apart longitudinally on an unpaved street 60 ft. wide between curbs, with a double track trolley line in the center. There was very little traffic and few underground structures to interfere with construction. The crossing streets were about 700 ft. apart, and the total length of the work was about 2½ miles.

The average size of the 436 dry pits was 8 x 8 ft. sq. and 10 ft. deep. The material was course sand, and the excavation was all above water level. All excavation was by hand, single cast for the first 5 ft. and double cast for the second 5 ft. Close sheeting of 2-in. plank was driven as the pit was excavated, and two sets of 6 x 6-in. rangers were used in each pit. The average gang was one foreman, two timbermen and 16 laborers; each foreman had one-half the time of a team and driver and one-eighth the time of a three-ton motor truck and driver. A payment line for excavation was set at 1 ft. outside the bottom of the compieted footing, and on this basis of measurement the total excavation amounted to 16,227 cu.yd. Sheeting was, however, driven to the neat lines of the footing, so that the actual excavation was only 10,570 cu.yd., or about 65% of that paid for.

Wet-pit excavation involved pumping; the pits varied

from 7 x 7 x 10 ft. to 9½ x 9½ x 12 ft., and the ground-water level ranged from 2 ft. to 9 ft. above the subgrade. Excavation was in sand overlaid by blue clay, peat, black mud and salt marsh. Calculated on neat lines, the yardage was 831, of which 385 cu.yd. was below water level. The pay excavation was 976 cu. yd.; tongue-and-groove sheeting was driven by hand and steam hammer, and the seepage was handled by steam pumps and gasoline-driven diaphragm pumps.

The accompanying table gives the expenditure in labor hours per cubic yard based on both the pay yardage and the actual yardage excavated.

The trench excavation aggregated 7417 cu.yd.; the trench was 3¾ x 5 ft. in dry sand for a 28-way duct-line. Sheeting was required only at manhole approaches and where crossing pipes made necessary a cut deeper than usual. The time cost per cubic yard was:

Item	Hours per Yard
Foreman	0.158
Timberman	0.353
Laborers	3.368
Team and driver	0.147
Motor truck and driver	0.086
Total	4.112

Overhead expenses were computed as follows; General overhead included bond premium; interest on capital invested; lost interest on retained percentages; interests on outstanding accounts; one-fifth of the main office expenses such as salaries, rent, supplies, telephone and legal costs, since there were four other jobs of equal magnitude being carried on at the same time, and field expenses such as superintendence, engineer, rent, supplies, telephone and postage. The total of these items was distributed among the several items of the

HOURS OF LABOR EXPENDED PER CUBIC YARD OF EXCAVATION FOR FOUNDATION PITS

	Dry Pits		Wet Pits	
	Pay	Actual	Pay	Actual
Cubic yards	16,227	10,570	976	831
Foreman, hours	0.111	0.170	0.892	1.048
Timbermen, hours	0.232	0.357	1.529	1.795
Laborers, hours	1.738	2.675	5.550	6.515
Team and driver, hours	0.066	0.102		
Motor truck and driver, hours	0.017	0.026	0.216	0.254
Engineer, hours			0.591	0.694
Pumpman, hours			0.613	0.720
	2.164	3.330	9.391	11.026

work; first, in proportion to the money value of the item and, second, in the ratio of the direct labor cost on each item. The amount charged as general overhead on any item was the mean of these two figures. Specifically, on the dry pit excavation the ratio for money value was $1210 and the ratio for direct labor was $4720. The figure used in the cost analysis was $2965, or one-half of the two sums.

In addition to general overhead there was a charge made for special overhead, figured on each item to cover cost of tools and supplies chargeable to the item, and depreciation of plant. Overhead costs include general and special overhead. They were, for the dry pit excavation: On direct labor, 29.6%; on labor, insurance and material, 23.8% and on total cost, 19.0%. For the trench excavation they were: On direct labor, 26.8%; on labor, insurance and material, 23.8% and on total cost, 19.3 per cent.

These figures indicate why contractors are loath to do extra work under a contract which limits the compensation for such work to the net cost of labor and materials, plus 10 per cent.

Road-Construction Problem in West Virginia Mountains

Narrow, Curved Roads With No Material-Storage Space—Especially Arranged Trucks Used for Hauling Effect Saving

By M. A. Rogers
Engineer in Charge for McDowell County, West Virginia

HIGHWAY construction in a mountainous country such as West Virginia presents many problems. The narrow, tortuous roads, with generally steep grades, make the delivery of materials and their storage upon the right-of-way difficult. A successful solution was reached in McDowell County, in building a concrete road from Welch to the Mercer County line, by the utilization of especially arranged motor trucks dumping batches of aggregate directly into the mixer hopper. This method not only expedited the work, but effected a large saving in labor cost.

A comparison of the cost of building a concrete road by the old method of dumping the aggregate on the subgrade with the method of using sectional trucks

NARROW AND WINDING RIGHT-OF-WAY GAVE LITTLE ROOM FOR STORING MATERIALS

shows that by the former an average of 28 laborers was required at the mixer, while with the latter only from eight to ten were required. Delivery of the materials from the railroad siding to the mixer hopper would cost about the same by either method. Where aggregates were dumped upon the subgrade it was also found that there was an average wastage of about 4% of the material, due to its washing away and being packed into the subsoil.

McDowell County is the most southern county of the state, and is situated in the heart of the Pocohantas coal fields and the Appalachian Mountains. The towns and colliers are in the valleys along the banks of the larger streams. The Norfolk and Western Ry., the only railroad, takes advantage of these valleys, and since there was nothing there previous to the railroad, it took the most advantageous locations, the towns springing up around it.

When roads were built to connect the various towns it was necessary to traverse the same valleys as the railroads. This caused many difficult problems for the locating engineer. As an example, the Class-A road here described crosses the railroad 12 times in a dis-

tance of 22 miles. By passages under railroad bridges and over tunnel portals, eight of these grade crossings have been eliminated; and two more will be eliminated by viaducts, the expense of which is divided between the county and the railroad company. The picture shows one such elimination by passage through an arch culvert. The original location is shown on the right.

Previous to 1917 all road money had been spent upon grading. At that time a bond issue for hard-surfacing the principal county roads was voted, and a contract was let for the Welch-Mercer County line road. It had been located and graded several years previously and had, with one or two exceptions, settled to a permanent position. The alignment had to follow the contour of the

CRUSHER BIN AND ELEVATOR USED FOR UNLOADERS

mountains on either side of the valley, but the grade was held to a maximum of 7%. The original grading allowed for 16 ft. from the toe of the hillside to the edge of the embankment, so it was decided to pave a 9-ft. strip in the center with concrete and place shoulders of macadam 2½ ft. wide on each side.

The native stone in the county is sandstone, and as this was analyzed and found satisfactory for paving purposes, the contractor opened three quarries along the road and started crushing operations. On account of the scarcity of labor these quarries were not very successful, and imported stone was used the second season. A rather novel use was made of part of the crushing plant. The elevators and bins were built over into unloaders for the hopper bottom cars. As electricity was always available, the elevators were operated by a motor. The picture shows such an installation under a railroad bridge, with a wooden hopper supported from the bridge to feed the elevator buckets.

Since the hauling problem is one of the largest items of cost on a road, this matter was studied very carefully by the contractor. A representative from one of the manufacturers of industrial railways spent several days looking over the situation, but could not advise their use on account of the sharp curves and excessive grades, not only in the road under construction, but in the approaches as well. It was also found that on account of the grades teams could not be used to an advantage. Auto trucks were finally selected, and a fleet of ten 2-ton trucks with hydraulic dumping devices were purchased. These trucks solved the hauling problem very satisfactorily, but even they had their disadvantages. When the roads were wet there was great danger in passing, and it was quite often necessary to excavate a considerable quantity of hillside to make safe turning and passing places. A turntable was designed for turning the trucks, but it was found to be too costly to install, on account of its having to be moved so often to keep in advance of the mixer.

During the first season the handling of materials for the concrete slab was done in the usual manner by dumping on the subgrade. This method had numerous disadvantages. Labor was scarce, and often only enough help was available to put a one-bag batch through the mixer. It was also found impossible to dump enough aggregate inside the forms to supply the mixer properly. If the materials were placed after the forms were set up the dumping threw them out of line; if before setting, the aggregate had to be shoveled to permit the placing of the forms. This increased the cost of the forms and undesirable material became mixed with the aggregate. Storing of cement was another problem, as there was no opportunity for hauling along the road after the aggregates were placed. Neither could any great quantity be stored in the roadway, because of its narrowness.

These difficulties were eliminated the past season by a different method of procedure. It was decided to

RAILROAD GRADE CROSSING ELIMINATED BY PASSING THROUGH ARCH CULVERT

operate only two mixers instead of three or four as in the previous season. This concentrated the organization, and the 2-ton trucks were distributed half to each job. The bodies of the trucks were equipped with three transverse partitions, making four separate compartments, each of which held enough of the aggregates for a two-bag batch of 1:2:4 mixture. The aggregates were received at railroad sidings, with a haul which was seldom more than 1½ miles, and which constantly lessened as the mixer advanced.

The bins for stone were placed at a height sufficient to allow a truck to receive its charge by gravity. The amount was measured by a stripe painted along the inside of the truck body. The sand was unloaded by hand and placed in stock piles along the siding. After the truck received its load of stone it went to the sand pile, where hinged measuring boxes which may be seen directly behind the truck in the illustration, were mounted on a narrow-gage car waiting to deposit the proper quantity of sand into each compartment. Four men were able at all times to keep the trucks supplied with sand. A description of the sectional trucks

and the hinged sand boxes was printed in *Engineering News-Record* of May 22, 1919, p. 1032.

When the scheme was first adopted the cement was also placed in the trucks, but this was found unsatisfactory, and special trucks were used to haul the cement to the mixer where it was placed in the mixer hopper while the trucks were discharging their batches. Three men, including the truck operator, handled all the cement, both loading at the storage and placing along the subgrade. When the trucks containing the aggregates arrived near the mixer they were turned and backed to the mixer hopper. The truck body was elevated, and each of the 4 batches was deposited in succession.

This method was a great labor saver, as no wheelers or shovelers of stone and sand were necessary. Other advantages were that the grade was kept clean; there was no foreign matter picked up from the subgrade; there was no waste material, and, above all, each batch contained the same amount, a thing which seldom occurs unless measuring boxes are used.

The records show that on a one-mile haul each truck made two round trips per hour. The entire gang required to get the material to the mixer consisted of six truck drivers, one mechanic and two laborers on the stone, four laborers on the sand, four laborers on cement, and two laborers caring for the grade at the mixer, filling up and cleaning up any material which spilled during the charging.

The mixing plant consisted of one boom-and-bucket type gasolene mixer, and one boom-and-bucket type steam mixer. The gasolene mixer was found to be just as reliable in every way as the steam mixer, and, as it was operated by one man, it proved the more satisfactory. Steel forms were used with much success, but on account of the many sharp curves in the road they were badly bent at the end of the job.

Water for the concrete, boilers, etc., was taken generally from Elkhorn creek. It was not satisfactory, on account of the dilute sulphuric acid from the many coal operations. Occasionally water from some of the collieries proved to be a much better quality. The finishing of the pavement was done by the belt-and-roller method, which proved very satisfactory, giving a smooth surface with a minimum amount of labor.

The work in McDowell County was done under the county officials, H. B. Wright being engineer, and the writer was engineer in charge. The contractor was the Harrison Engineering & Conctruction Corporation, of Buffalo, N. Y. of which H. B. Harrison is president.

Ratio of Fine to Coarse Aggregate Basis for Concrete Mixtures

ANOTHER method of proportioning concrete mixtures is proposed by R. W. Crum, in a paper, read before the American Society for Testing Materials, and entitled "Proportioning of Pit-Run Gravel for Concrete." The method was devised for and is specially applicable to Middle Western gravels which occur in assorted gradings. By its use a proper concrete can be had with any pit gravel by the addition of the correct amount of cement, to be determined by the method. Basically, the author's scheme rests on the assumption that the ratio of cement to air and water voids is an indication of strength. In other words, the nearer the cement content approaches the volume of the voids the greater is the strength of the concrete. He assumes that for certain classes of concrete—that is, for concrete to be used under certain conditions—there is an optimum sand-aggregate ratio. In that ideal mix the cement-void ratio is computed and the amount of cement necessary to bring the actual mix up to that ratio is found. This gives the best mixture—reducing to loose volume—for that particular aggregate. Although the author states that the proper grading depends upon the consistency or amount of water in the mixture, and although he says specifically that one must get a concrete which will yield a workable mixture for the conditions under which it is placed, he does not tell in the paper just what degree of workability is reached by his method nor the standard of consistency or workability which was used in making the tests. He claims that the method gives results about midway between the fineness-modullus method of Abrams and the surface-area method of Edwards. Analyses of prospective aggregates may be readily made in the field for the method, inasmuch as it requires only to be known the gradings above and below a No. 4 sieve.

Fireproofing Concrete Columns with Plates

Certain kinds of aggregate, particularly quartz gravel, have proved to be dangerous components of concrete which may be subjected to fire. In an investigation of the fire resistance of such concrete, Walter A. Hull, of the United States Bureau of Standards, Pittsburgh, made a number of tests on concrete columns under simultaneous load and fire conditions. These tests were reported at the recent meeting of the American Concrete Institute. An interesting feature of them was the use of a plaster coating of one kind or another as a fire-resistant medium. These coatings were applied both as a plaster and as an original form in which the concrete column was cast.

Mr. Hull's deductions as to the somewhat limited tests already made are as follows: "Observations made in casting columns and forms made by covering the spiral reinforcement with metal lath indicate that such an expedient would be practicable in cases in which it might appear desirable to substitute other protective material for the protective concrete ordinarily provided. Gravel concrete columns with vertical and spiral reinforcement over which part or all of the thickness of the protective covering had been provided in the form of cement plaster gave better results than columns of the same type with the usual concrete protective coating, but much poorer than columns from trap rock, blast-furnace slag and limestone aggregates with protective concrete in the usual form. The comparatively poor results shown by these plaster protected columns are consistent with the observations reported, namely, that a large part of the outer coats of plaster separated and fell off, leaving practically only the fire coat for protection during the latter part of the fire tests. One column, in which the protective covering was a special mixture, mainly asbestos, portland cement and sand applied in the form of plaster on the column, made by pouring concrete in metal lath placed on the outside of the spiral withstood the test of 3480 lb. per sq.in. at the end of the 4-hour test and failed under a load of 4930 lb. per sq.in." The report of the Committee on Fireproofing of the American Concrete Institute abstracted on p. 76 is of interest in this connection.

SOCIETY SERVICE

A Section Dealing with
the Results of Teamwork by Technical Men

Kansas City Club to Get Growth Data On Which to Base Civic Opinion

The collection of basic data on traffic and transportation, and the future requirements therefore, has been undertaken in a comprehensive manner by a recently appointed committee of the Kansas City Engineers Club. The committee grew out of a desire on the part of the club to be able to express itself as a unit on matters of civic interest. It had long been recognized that many worthy projects died from lack of political support, and the latter was too often given only when the compelling motive of self interest was dominant rather than a wholesome knowledge on the part of the voters that the matter under consideration was of vital interest to the city as a whole.

In the first progress report of the committee, June 27, Howard P. Treadway, chairman (they call each other by their first names in Kansas City), outlined the scope of the work. It is the intention to have many sub-committees, thus putting many of the new and younger members to work. Some of the topics to be taken up by the sub-committees are as follows: Population growth as affected or indicated by freight house statistics, by registration of voters, by the school census, by auto licenses, by building permits, by the distribution of gas mains, by the street car traffic, by the electricity demands, and by the growth and relations of small business and industrial centers. There is no city planning commission functioning in Kansas City. The engineers may make it unnecessary.

Question Asked Members About Pending Congressional Legislation

How one local engineering society is serving its members and the public at the same time is shown by the following extracts from a recent multigraph bulletin issued by W. H. Woodbury, secretary Duluth Engineers' Club:

LEGISLATION UNDER CONSIDERATION BY THE 66TH CONGRESS

Good Roads Act—Proposes to take administration, construction and maintenance of roads out of Department of Agriculture and place in the hands of a special commission of three or five $10,000-a-year men. Is it advisable to disrupt present organization which is coöperating with the state road officials? Secretary Houston makes statement of reasons for his opposition and sets forth some very cogent arguments. Is a commission the best method of administration? Is it well for the Federal roads to be administered independently of the state officials? Should the salary of the directors of the Bureau of Public Roads be raised to $6000 from $4500? Is $6000 enough?

Engineering Research—One bill provides for engineering experiment stations in each state. Annual cost $2,400,000. It opens the door for endless controversies between various colleges seeking preference. Another bill (see *Engineering News-Record*, June 5, p. 1131) provides $15,000 for each state (total of $720,000), to be expended in research under the direction of a board.

Flood Control of the Colorado River—A bill providing $50,000,000 to build flood control dams and lease power rights. Is the plan feasible? Will the storage basins soon fill with mud? Would power companies develop the power? Are levees a better plan? Shall the U. S. Government take on this job? Our Congressmen must vote on this proposition. How do we want them to vote?

The National Budget—Several bills are proposed. One by Chairman of House Committee on Appropriations. This committee has opposed a budget in the past. It is now probably ready to accept this reform, for which the country should be thankful. This bill provides a budget bureau subordinate to the President that shall group information as to governmental finance, income and outlay. The bill also provides for a joint committee of three members from each house of Congress to consider income and outlay. Best of all, Secretary of the Treasury is to revise, change, unify and otherwise consider all such matters to prevent loss, waste, etc. Several other bills have been presented and since most any change would be an improvement we may have hopes.

Mining on the Public Domain—There are several bills to permit development of natural resources. Seemingly fairly good and safe measures have been lost in wrangles over petty details or by filibusters in the recent Congresses. This legislation is undoubtedly needed and it would seem that engineers should study and advise their representatives, aiding them in rightly solving the problem. Several water-power bills are again up and it would seem time some constructive action were taken. More occasion for engineers to assist in a correct solution. If not engineers, who? (See *Engineering News-Record*, June 5, p. 1130.)

If we don't acquaint our representatives as to our wishes how can they act upon them? Our duty as citizens demands that we give our country the benefit of our peculiar training in these matters of grave public interest. Otherwise we are slackers.

Engineers who have had experiences with the War Department that give cause for just complaint, or engineers who find themselves unable to induce the Department to fairly review their claims or complaints, are invited to state their case to the National Service Committee, M. O. Leighton, chairman, McLachlen Building, Washington, D. C. A typical case is described in *Engineering News-Record*, June 5, p. 1132.

Engineering News-Record, May 29, p. 1073, carries an article on what engineers in Iowa accomplished regarding desired legislation. Read it. It contains a typical speech. Perhaps engineers get about as much consideration as they deserve. We can get results if we go after them.

Milwaukee Society Has Active Committee On Civic Affairs

When a bill affecting the public interests of Milwaukee, Wis., by changes in the membership of the sewerage commission was introduced in the Wisconsin legislature recently, the matter was taken up by the Engineers' Society of Milwaukee through its committee on civic affairs. After investigation a report adverse to the proposed amendment was printed and distributed, giving the following three reasons for opposition: Lack of necessity of the proposed change; failure of the change to effect its purpose owing to certain conditions outside of the law in question, and desirability of avoiding the political influences which would be introduced. The bill was passed by the legislature but the opposition was such as to lead the governor to veto the bill.

This committee was appointed last winter and is expected to keep the society continually in touch with public affairs, thus enabling it to perform its civic duties to better advantage. It has now three subjects under consideration: The qualifications for the position of city building inspector and the organization of

his office; the arterial highway system now being studied by the public land commission in connection with city planning; the city's water filtration plant and its location. It reports to the council of the Society and this body alone has authority to make the results public.

Previous to the appointment of this committee the Society's work in regard to public affairs had been done partly through special committees. In 1914 a committee on street lighting made a report which was adopted by the Society and the recommendations of which have been followed by the city. Another special committee was appointed in 1916 to consider the feasibility of closing the Milwaukee River to navigation by large vessels and replacing the drawbridges with fixed structures. The report, noted in *Engineering News-Record* of Sept. 27, 1917, page 608, was adopted by the society but has not been acted upon by the city.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Accident-Prevention Highway Spurs at Railroad Grade Crossings

Sir—When approaching a railroad crossing the other day, in company with a civil engineer, I made the remark that it would be a splendid thing for both automobilist and the railroad if the railroad would construct at each grade crossing a road running parallel with the tracks, so that if an automobilist were threatened with collision, he could turn his car to the right or left, and thus avoid hitting the locomotive or the moving train. Such a road should be banked, so that the automobilist could make a short turn without difficulty, even though the car were traveling as fast as 30 miles an hour. The civil engineer thought so well of the idea that he urged me to write you.

Experience has shown me that it is impossible for the automobilist to see, at 99 grade crossings out of 100, whether a train is approaching from either direction, until his car is either upon the tracks or so near them as to make it practically impossible for him to stop if a train were approaching. A banked road running parallel with the railroad tracks on both sides would enable him to escape accident in the majority of cases, and need not be more than 150 ft. in length.

For example, a chauffeur turned to the left at the Leonia, N. J., crossing of the Northern R.R. of New Jersey the other day, but, having no roadway to run upon, he was compelled to take to the rails, and the car was overturned, killing the chauffeur, but saving the lives of the passengers, none of whom was seriously injured. Had there been a roadway as suggested above, the driver could undoubtedly have saved both himself and his machine.

No doubt the maintenance-of-way departments of the railroads will declare that in a great many cases it would be impossible to build such a roadway, owing to the lack of room and other reasons, but this could be overcome.

This leads me to point out another fact, which is common to the experience of automobilists; and that is, that the rattling of the auto makes it almost impossible for one to hear crossing bells, should a bell be ringing; for which reason the railroad should place a signal at least 150 ft. distant from the railroad tracks, which would warn the automobilist that a train is approaching.

Crossing signals, consisting of red lights, have been installed by the electric railway between Paterson, N. J., and Suffern, N. Y., over all grade crossings. When lighted, even in the day time, the red lights are visible at a considerable distance, so that there is ample time for a driver to stop his car. A signal of this kind should be installed by the railroads, so that the driver may depend upon his eyes for the warning signal, rather than upon his ears.

I trust that these two suggestions may receive reasonable consideration, as the application of them would undoubtedly save many lives, prevent many grade-crossing accidents, and save the railroads thousands of dollars in damage suits to which they are now subjected.

It is needless to argue that most automobilists are reckless, because the average driver has no desire to risk his own life, or the lives of his family and friends, and only a very few take wilful chances.

ALBERT L. WYMAN,
Paterson, N. J. Secretary, Employers' Association.

"Common Surveying" and Engineers' Unrest

Sir—President Palmer C. Ricketts, of Rensselaer Polytechnic Institute, makes some statements in his letter published in your issue of May 29, 1919, p. 1075, which may disclose one cause for the tendency toward unionism among young engineers. In commenting upon letters heretofore published relative to compensation for engineers he says: "The complaining letters are most frequently written by surveyors and draftsmen. The difficulty is that common surveying and ordinary drafting are not difficult to learn, and the law of supply and demand takes care of the pay for this kind of work."

Not having studied unionism as it may apply to the engineers, I make no comments thereon. I have but little to say about drafting. It is recognized that engineering schools are not preparing young men as real draftsmen today. Where art had some recognition in required courses of study twenty years ago, commercialism now controls the field. Engineering schools attempt to "supply" the "demand" rather than to prepare young men for leadership in this branch of engineering.

Apparently, the only antidote for drudgery is unionism. The man who masters his work, however trivial it may seem in the eyes of others, falls in love with it. He never has time to become despondent. His work is his stimulation. "Common surveying" and "ordinary drafting" are terms that he never employs. If our engineering schools were to eliminate much of the professional work of the last year or two, and devote the time thus made available to instruction in courses that are fundamental to engineering, young engineers would have a better chance to grow naturally in their professional careers. In order that engineering schools may acquaint young men with a few small areas within

the great field of professional practice, many fundamentals have been crushed and their inspirational qualities have been almost destroyed.

Rare individuals among engineers have been able to prepare themselves properly while struggling toward the final goal of success. The rank and file lag behind these leaders, largely because they have not been inspired by anything that has come to them in the classroom, the laboratory or the field. Some of these leaders look back occasionally from the heights they have attained, and, as they view the multitude, their brethren, they lapse into philosophical dissertation. They are inclined to apply laws, almost obsolete in the realm of economics, in support of their judgment of those who try to climb the professional ladder under handicaps unknown when engineering training was more catholic and inspiring.

Surveying is generally designated as common when not performed properly or not performed at all. Too many schools teach surveying as an automobile demonstrator teaches a timid woman to drive a car. Students enter classes in surveying to receive instruction in the use of the transit and the level and to apply some of the simple formulas of plane trigonometry. Instruction of this kind may deceive young men. It may satisfy the conscience of the rough-and-ready educator. Some schools may "get by" under such a practice for a long term of years. In the meantime, however, surveying is neither an applied science nor a stimulating branch of engineering theory. Until engineering educators recognize conditions and apply remedies, the country will continue to suffer because of poor surveying and our young engineers will continue to talk of unionism.

Those who classify branches of engineering in the light of compensation paid for service should analyze the cause for unrest among young engineers. If these young men had been trained in fundamentals before they undertook the study of surveying, they would afford an uplifting influence in the latter field. But few branches of engineering are more exacting than surveying. To the man whose ambition centers about a swivel chair and who hopes to avoid physical exercise while earning his daily bread, surveying will probably never offer inducements. The young engineer who has never been inspired by the study of surveying will not be likely to prosper in the practice thereof.

Any branch of engineering becomes unattractive when engineering schools cease to give instruction in the fundamentals that should support it. Surveying is not based altogether upon applications of trigonometry. It does not consist altogether in the use of surveying instruments. Find the man who loves surveying and you find a contented citizen and a leader of his community. He will be able to tell you something about the probable error of measurements made under varying conditions. He will know something about the proper balance in degree of accuracy between lineal and angular measurement. He will understand how the cost of work increases with precision. He will not entertain arguments designed to induce him to lower limits of accuracy, and hence the cost of surveys, because of land values. He realizes that land values fluctuate, and he does not want his reputation ta fluctuate therewith. He will understand something of the economics and law of surveying. Instead of juggling with the formulas of trigonometry exclusively, he also applies analytic geometry, descriptive geometry, calculus, least squares, astronomy, physics and even chemistry in his every-day activities. Geology, botany and forestry will guide him in many of his field operations.

His work might be designated as "common" by the casual onlooker. Engineers should not join the layman who thus passes judgment. The survey of property, political and geographical boundaries, has always been and will always be his most important field.

No branch of engineering makes a greater appeal for aid and sympathy than surveying. Probably the greatest losses suffered by employers of engineers have occured in this field. We failed to provide highly trained men when they were sorely needed, and it was necessary to draft incompetents to the service to build up the army that subdivided the public domain. These men, at a later date, naturally became local practitioners of surveying. While other countries placed work of this kind on a scientific foundation, the politician and the land speculator have dominated here. The engineer did not have courage enough, evidently, to fight the system. By his silence he has passively given it his approval.

When engineers begin to lay a foundation for a profession, one of the cornerstones must be surveying. When this stone has been properly wrought and carefully bedded in the cement of fundamental training, the engineers of the country will have taken a step which will guarantee the respect of a great element which estimates all kinds of engineering from a superficial view of activities in this most general branch. Engineering educators should proceed on the theory that any kind of engineering may be made pleasant and profitable when properly supported by the essential fundamentals. Fundamentals furnish the soil in which professional pride and satisfaction may grow. Every branch of engineering that is now popular, because of the high compensation it affords, is threatened with a blight which spreads as engineering schools increase the burden of required professional work at the sacrifice of things that guarantee stability, self-reliance and contentment in the realm of practice.

CLARENCE T. JOHNSTON,
Professor of Geodesy and Surveying, College of Engineering, University of Michigan.
Ann Arbor, Mich.

Transit or Plane-Table for Topography?

Sir—I see occasionally in your publication articles on topographical surveying by engineers who have almost invariably used a transit, and have used ingenious and what seems to me laborious methods, to accomplish what could have been done more easily with a plane-table. I am not alone in this opinion, having heard it expressed often by former railroad engineers who have joined the United States Geological Survey, where all topography is done with the plane-table.

To operate a plane-table efficiently, one has to be an accurate draftsman and have considerable experience. I think an experienced plane-table man can work as rapidly as a transitman, get results as accurate as can be plotted and pick up all mistakes in the piece. I would like to see this discussed.

HARGRAVES WOOD,
Martinsburg, W. Va. United States Surveyor.

HINTS FOR THE CONTRACTOR

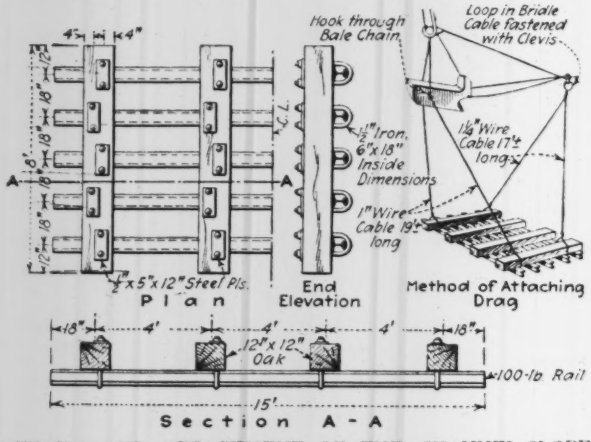
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Special Drag Finishes Channel Slopes Dug by Dragline Excavator

BY B. LOUIS ZULL
Dayton, Ohio

FINISHING channel slopes, which were formed with a dragline excavator, by dragging them with a special device formed of steel rails, has been resorted to on the Dayton, Ohio, channel work of the Miami Conservancy district. A 3½-cu.yd. dragline bucket was found to be impracticable for finishing to grade the river channel slopes, as it left ridges on either side of the bucket at every drag. Even the surface under the bucket, while smooth, was wavy. A heavy drag, constructed as shown in the accompanying sketches, was finally built and found to be very satisfactory in obtaining the finish.

The drag, as constructed of 100-lb. rail and oak timbers, weighed in the neighborhood of 4500 lb., and when in use was attached to the regular dragline as shown in the sketch. After the dragline had dressed the channel slope to the approximate surface, the drag was hooked to the bucket and pulled over the rough



DETAILS AND ATTACHMENT OF THE CHANNEL-SLOPE FINISHING DEVICE FOR DRAGLINE EXCAVATION

surface. If humps were left after the first trip, they were cut down either with the bucket or by a second trip of the drag carrying extra weight. Holes were filled in with the bucket and leveled off with the drag. About 25 to 30 lin.ft. of slope was cut to grade and dragged at each move of the machine, and probably 10 min. of working with the drag finished the section to a smooth surface.

Most of the channel slopes were between 3 and 5% and extended from the toe of the new levees to a point near the center line of the channel. Less than half of this was covered by water, and this portion was not dragged, except about 20 ft. from the water edge. Each of the two big electric dragline machines on the Dayton work was equipped with finishing drags of this type.

C. A. Bock is the division engineer of the Dayton channel improvement work, and H. A. Honson is superintendent and responsible for the construction of the drag.

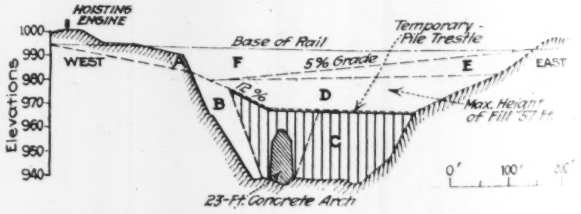
Other Articles in This Issue of Interest to Contractors:

The Relative Economy of Freight Transport by Railway and by Motor Truck Page 52
Concrete Building Addition Made at Reasonable Cost Page 75
Overhead and Time Cost of Pit and Trench Excavation Page 89
Road Construction Problem in West Virginia Mountains Page 90

Cable Incline Handles Dump Cars in Building Wet Fill

TO BUILD a lead track giving access to the site of a new car-repair plant for the Pennsylvania Lines at Richmond, Ind., it was necessary to cross a ravine by a fill about 600 ft. long and having a maximum height of 57 ft., and to commence this work in advance of the 23-ft. concrete arch culvert. The work had to be done from the west end, where grading for the repair plant required an average cut of 10 ft., but there was no track connection with either end, while a hill and a second unfinished bridge lay beyond the east end, so that the work was inaccessible for heavy construction equipment. Furthermore, no timber suitable for a high dumping trestle was available under war conditions, and shortage of labor made it necessary to use light equipment which could be operated by a small force.

A small revolving steam shovel was operated along the top of the west slope until it reached the center line of the new lead track, at which point it was 10 ft. below grade, as shown at A in the accompanying section. The shovel then worked westward along the line of the



PROFILE SHOWS STAGES OF BUILDING A HIGH FILL

lead track, loading dump wagons which made the first part of the fill at B. While this work was in progress a temporary pile trestle 30 ft. high was built across the ravine.

Dump cars of 3-yd. capacity on a track of 3-ft. gage were loaded by the steam shovel and hauled by a dinkey engine, but this engine could not operate on the 12% incline from the track level to the trestle. A hoisting en-

gine was installed, therefore, near the top of the slope with its cable operating two-car trains for making the fill C, east of the concrete arch, which was then under construction. After the arch had been completed the fill was extended over it and then the upper part of the fill, shown at D, was made by dumping material along the top and jacking up the construction track as the filling progressed. Only two men were required on the fill to dump the cars and raise the track as the fill was brought up to grade.

Operation on section D was carried on in this way as long as there was sufficient grade to run the loaded cars by gravity to the east end. Then the east end of the track was taken up and the 3-yd. cars and the dinkey at the west end started the fill E, with an ascending grade of 5% to the east. By the time this had been completed the construction of the second bridge (to the east) had progresed sufficiently to permit of reaching the work with heavier equipment, and fill F was then built by standard-gage dump cars and spreaders, bringing the top to the finished subgrade level.

The cost of that part of the work which was carried out by the light equipment was 22.5c. per cubic yard, including the cost of the trestle.

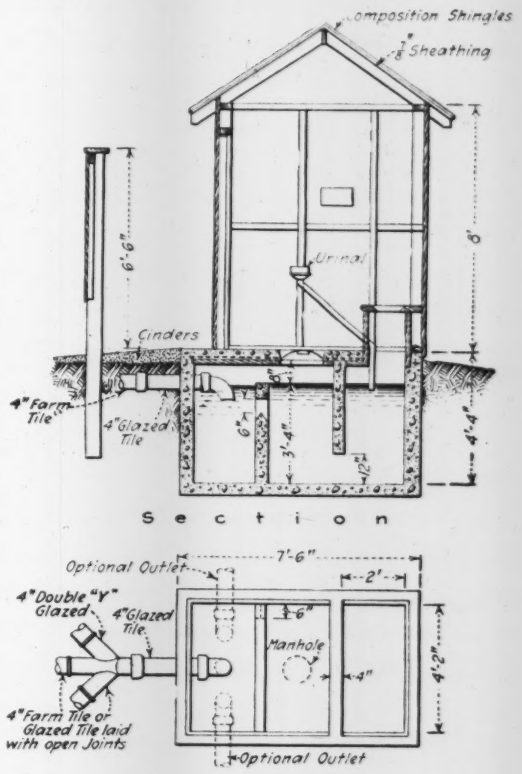
Considerable slipping occurred in this fill and in an adjacent fill of about the same height for widening the freight yards, due to the fact that they were made with yellow clay which when wet had an angle of repose of only about 10°. As the fills slipped and settled they were topped with cinders to carrythe construction track and then raised again by dumping more clay. Water getting into these successive strata of cinders and unable to escape through the clay flowed out at the sides and caused washing of the slopes. The trouble was stopped by blanketing the slope with a bed of cinders through which the water flowed.

This filling was done by railway forces. W. C. Wolfe was engineer in charge of construction, under S. W. Hodgin, division engineer, and Robert Trimble, chief engineer of construction of the Pennsylvania Lines.

Camp Sanitary Closet With Septic Tank

A SANITARY closet with septic tanks, for temporary or permanent camps, based on a standard design used by the Nashville, Chattanooga & St. Louis R.R. at section headquarters and small outlying railway stations, is suggested by the committee on economics of railway labor, American Railway Engineering Association. The design used by the railway is shown in the accompaning drawing, but the committee omits the urinal and considers that the tank might be of either concrete or wood. Additional units could be built as required. Ordinarily, the discharge pipe terminates in a bed of cinders, streams being seldom available on this railway. The manhole cover is of concrete, made in a tin form, and has a sloping top. The form is set on the floor form and concrete is poured around it, the cover being raised carefully to loosen it before the floor concrete has taken its final set.

Instructions on the railway company's blueprint direct that before the house is erected the tank be filled with water and five shovelfuls of well rotted horse manure added "to start the chemical [bacterial?] action"; also that at least 4 gal. of water be poured into the tank daily through the seat. This is for locations where water cannot be piped to the tank. The instructions also call for the provision of toilet paper and forbid the use of newspapers as a substitute.



SANITARY CLOSET AND SEPTIC TANK FOR RAILROAD

BILL OF MATERIAL FOR SANITARY CLOSET WITH SEPTIC TANK

25 sacks cement.
2.5 cu.yd. sand.
4.5 cu.yd. crushed stone.
6 pcs. 2x4-in., 10-ft. 0-in. plates and rafters, No. 1 common pine.
4 pcs. 2x4-in. 12-ft. 0 in. plates, No. 1 common pine.
5 pcs. 2x4-in., 16 ft. 0 in. studs, No. 1 common pine.
4 pcs. 4x4-in. 8 ft. 0 in. studs, No. 1 common pine.
1 pc. 2x6-in. 10 ft. 0 in. plates, No. 1 common pine.
2 pcs. 6x6-in. 10 ft. 0 in. posts, No. 1 common pine D45.
1 pc. 2x8-in. 10 ft. 0 in. cap, No. 1 common pine D45.
2 pcs. 1¼x4-in. 10 ft. 0 in. verge boards, No. 1 common pine D45.
250 ft. 1x6-in. shiplap siding No. 105, No. 1 common pine.
8 pcs. 1x4-in. by 8 ft. 0 in. corner boards, B. fin. pine D45.
6 pcs. 1¼x5½-in. 10 ft. 0 in. No. R-C flooring forms, pine D. & M.
1 pc. 1¼x20-in. 5 ft. 0 in. closet seats, B-grade white ash.
1 pc. 1¼x22-in. 5 ft. 0 in. closet seats, B-grade white ash.
2-12x12-in. louvres.
110 ft. No. 1-C flooring, ¼x3¼-in. D. & M. pine.
200 ft. No. 2-C 1x6 in. flooring, forms D. & M. pine.
80 ft. ⅞-in. sheathing, No. 2 common pine, 1x6 D. & M.
4 sqs. composition shingles, red.
1 joint glazed pipe, 4 in.
1—4-in. round L, glazed pipe.
1—4-in. double Y, glazed tile.
6 joints, 4-in. farm tile.
8—½-in. bolts, 6-in. long, machine bolts with nuts.
40 sq.ft. expanded metal at 6 lb. sq.ft., diamond mesh.
5 lb. 20-d. nails.
18 lb. 8-d. nails.
4 lb. 6d. nails.
8 lb. tinner's nails.
1 pr. 6-in. T. hinges.
1 gal. 15 green, and 2 gals 23 yellow paint.
1 c.-i. lock complete.
1 urinal complete, L.M. Ramsay Mfg. Co.'s. No. 1 plate 1023 lb. Flat back, painted.
2—45 deg. turns, 1¼-in. pipe.
4 lin.ft. 1¼-in. pipe.
1 toilet paper rack and 1 case toilet paper.
1 enamel sign giving directions.

The bill of materials drawn up by the engineering department of the railway is reprinted herewith. The approximate cost of the closet and septic tank is placed at $142.

NEWS OF THE WEEK

New York, July 10, 1919

Gulf to Atlantic Canals Proposed

A bill has been introduced into the House of Representatives (H.R. 6560) providing for a survey and estimate of cost of a sea-level or lock ship canal from the Atlantic Ocean to the Gulf of Mexico. The proposed route is from the mouth of the Altamaha River in Georgia through a series of rivers in Georgia to the Apalachicola River in Florida, thence down that river to its mouth in the Gulf of Mexico. Another bill (H.R. 6558) provides for the survey of a similar canal from Cumberland Sound, on the Atlantic Ocean, up the St. Marys River, across the States of Georgia and Florida, to some point at or near St. Georges Sound on the Gulf of Mexico.

Congress Authorizes State Agreement Concerning Hudson Tunnel

Permission was granted by Congress during the past week for the States of New York and New Jersey to agree together in the matter of the construction of the Hudson River tunnel. This permission is necessary under the Federal constitution. No financial aid by the United States is in question, the two states having already provided money for beginning the work.

Joint Committee on Concrete Pipe Organized

Organization has been effected of the joint committee of various societies to prepare specifications on concrete pipes and culverts. The societies joining in are the American Railway Engineering Association, the American Association of State Highway Officials, the American Concrete Institute, the American Society for Testing Materials, and the Concrete Pipe Association. The first sub-committee which is actively to begin work is one which is to prepare specifications on culvert pipe.

States Rapidly Taking Allotment of Federal-Aid Funds

The rapidity with which the states are taking advantage of the Federal-aid funds appropriated at the last session of Congress is indicated by the fact that during the month of April Federal aid in agreements and approved statements to the amount of $9,559,571 was allowed on work which will cost $20,861,958. Some states took record amounts of aid, among which was Pennsylvania, which has the record for any one month, the amount of Federal aid approved being $1,444,967.

In a single project in Illinois, which was approved, $818,222.75 of Federal money, which is half the cost, will be used. The total of approved statements and agreements made by the Bureau of Public Roads during April was a considerable increase over the March record, the number of projects being 174 as against 150 in March, with a mileage of 1444 as against 1270. This was an increase in allowances of about $2,820,000.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment Service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

French Engineers Visit This Country

Six French engineers, architects and contractors, forming an official commission, are visiting this country to study various American developments which would aid the French Government in their reconstruction plans. The party is composed of Jacques Greber, architect; Pierre Nugue and Victor Perreaud, engineers; Réné Bonhomme, building contractor; Charles Jacob, sanitary engineer, and Dr. Paul P. Cret, who before the war was professor of architecture at the University of Pennsylvania. The commission is studying particularly the various housing developments in this country and is visiting besides industrial centers for the purpose of studying mill construction and operation. It probably can be reached by addressing Dr. Cret at the University of Pennsylvania.

New Highway Bill in Congress Provides New Department

A bill has been introduced in the House of Representatives by Mr. Osborne of California to establish a national highway system, to promote efficient and economical highway transportation, and amend the Federal-Aid road laws so as to create a Department of Federal Highways. The bill is similar in intent to the Townsend Highway bill, but appropriates a much larger amount of money, and establishes a new government department with a new cabinet portfolio instead of a commission.

If the bill should pass it would appropriate $1,700,000,000, divided as follows: $100,000,000 to become available 30 days after the enactment of the bill, $200,000,000 for the fiscal year ending July 1, 1920, and a like amount for each of the following seven years. All of these sums would remain available until expended. The bill also provides for a secretary at a salary of $15,000 per annum, appointed by the President and confirmed by the Senate, and an assistant secretary at $10,000, with such other employees as may be necessary. Except for special employees, the force would be under the classified civil service. Following is a quotation from a summary of the bill appearing in the weekly review of the Chamber of Commerce:

> The department would provide a connected system of highways sufficient to maintain interstate commerce, furnish adequate post road facilities and provide for the national defense. It would establish trunk lines of national highways (a) from the Atlantic to the Pacific (not less than three in number), (b) from the northern to the southern boundary of the United States (not less than two in number) and (c) intersecting and feeder lines (not less than two) in each state. These trunk line roads would form a national highway system.
>
> The Secretary of Federal Highways would determine (1) the routes upon which national highways would be constructed, (2) the highways to be included in the system, and (3) the order in which they are to be built and maintained. In making selections he would be required to keep in mind the formation of a national system of trunk line roads with intersecting and connecting highways adequate for the purposes of the bill. The Secretary would have charge of all work in connection with the construction, maintenance, etc., of these roads, preparing estimates, plans specifications, and might make arrangements with states, counties and municipalities for the taking over and administration as part of the federal highway system of roads in these subdivisions.
>
> The roads included in the National Highway System would be built, and maintained entirely at the expense of the United States, and administered through the Secretary of Federal Highways. Beginning July 1, 1919, and annually thereafter until the first day of July, 1926, the Secretary of the Treasury would be authorized to issue National Highway Bonds to the amount of the appropriation provided for that year. The rate of interest, time, etc., as to each issue would be determined by the Secretary of the Treasury.

California Highway Bond Issue Carries by Large Majority

The bond issue for $40,000,000 has been carried in California by a large majority. The vote for the proposition is reported to stand about 7 to 1, with every precinct in the state voting in the affirmative. This is the third bond issue for highways authorized in California and makes a total of $73,000,000 for this purpose in the last decade.

By this bond issue the completion of the present state highway system and the construction of many new highways distributed throughout the state in such a manner as to round out the present system and to adequately serve the entire state is provided for. The state system has 4500 miles of highways. This adds another to the growing number of states which have voted large highway bond issues during the last year.

Second Large Concrete Ship Launched

At the Mobile, Ala., yard of the United States Emergency Fleet Corporation, there was launched on June 28 the second of the 7500-ton reinforced concrete vessels designed by the Concrete Ship Section of the Board. This ship was named the "Selma" and was built in the yard which was under the direction of Fred T. Ley & Co. as contractors before the government took over the operation of all of the concrete shipyards.

Milwaukee Sewerage Commission To Remain Unchanged

Although a bill proposing to amend the present sewerage law of Wisconsin by making city engineers eligible to appointment on such commissions was passed by the legislature, it was vetoed by the Governor. The bill was opposed by the civic affairs committee of the Engineers' Society of Milwaukee. In its report on the subject the committee stated that the bill "seems to have been introduced because of a certain amount of dissatisfaction with the sewerage commission of Milwaukee, which resulted in certain charges being made against its chief engineer some time last fall."

Two arguments in favor of the amendment were mentioned in the report. One was that the city should have a representative on the board who is capable of checking the plans and informing the city government as to the progress of the work. The other is that when the works are completed they will be turned over to the city for operation and maintenance. The committee considered that the city engineer now has the privilege of examining and checking the plans and that as the progress of the work has been made a matter of public record there is no ground for suspicion of secrecy. The committee saw no objection to the appointment of an engineer as a member of the board, but urged that he should act as a commissioner only and not as an engineer, since the latter system would introduce danger of divided responsibility.

As to operation and maintenance, it was pointed out that the city engineer's term is limited by charter to three years, so that there is no assurance that an engineer appointed as a member of the board during the period of design and construction would be connected with the future work of operation. Further, it was pointed out that with the "grostesquely low salaries offered by the American municipality for its professional help" there is no assurance that the city's representative would be competent to intelligently review and check plans for sewage disposal in a city such as Milwaukee.

The strongest argument, however, seems to have been that the amendment would introduce a political element into the board. The committee stated that the intent of the original law was to place the work in the hands of a body of men as free as possible from political influences and ties. For this reason the law excluded all persons holding any city, county or state office or office in any political organization. The committee stated that the bonds for the work were voted on this understanding and that to permit this bill to become law "would be to break faith with those who voted in favor of the bond issue."

Cost of Bonds on Construction Contracts in Dispute

The construction contracts of the War Department during the war, placed upon a cost-plus basis, include the list of costs for which the contractor was to be reimbursed by the government—"such bonds as the contracting officer may approve or require." Contractors were required to furnish bonds for the faithful performance of the contract and for payment of all bills for labor and material. The language of the contract form declares that the contractor shall furnish such bond "prior to commencing the said work." The disbursing officers of the United States uniformly accepted this as sufficient authority for reimbursing a contractor for the premium on his bond, paid by him.

No doubt was entertained on this subject until quite recently, when some decisions of the comptroller's office led to an inquiry by a disbursing officer as to his authority. The assistant comptroller, in an opinion recently rendered, declared that the form of cost-plus contract in use by the Construction Division does not authorize reimbursement to contractors of such premiums. This has been reaffirmed in another advance opinion by the comptroller. It is understood that disbursing officers who have already made such payments are charging the payments back to contractors and deducting them from their final vouchers.

The understanding is also that premiums paid on earlier construction contracts will be deducted from the final payments on later construction contracts, and that if the decision is adhered to finally an effort may be made to collect the premiums already reimbursed upon settled contracts. The matter is of wide interest, as the total sum involved is of magnitude. Daniel A. Garber, president of the Associated General Contractors, Inc., has taken this subject up with the intention of securing a reversal of the present ruling either by the comptroller on review or, failing that, by the Court of Claims. With this end in view, he has obtained the opinion of King & King, of Washington, D. C., attorneys for government contractors, to the effect that the deduction is not authorized by law and by the contract and that, in all probability, the contractors can be protected in their right to this reimbursement. Steps have been already taken toward the presentation of a test case.

Texas Association of Contractors

The Texas Association of General Contractors, comprising contractors engaged in general construction work in Texas, which was recently organized, has opened offices in the First National Bank Building of Houston.

The following officers have been elected: President, George F. Horton; vice-presidents, George Watson and Robert J. Potts; treasurer, Charles M. Davis; secretary, Jerome Cochran, Houston.

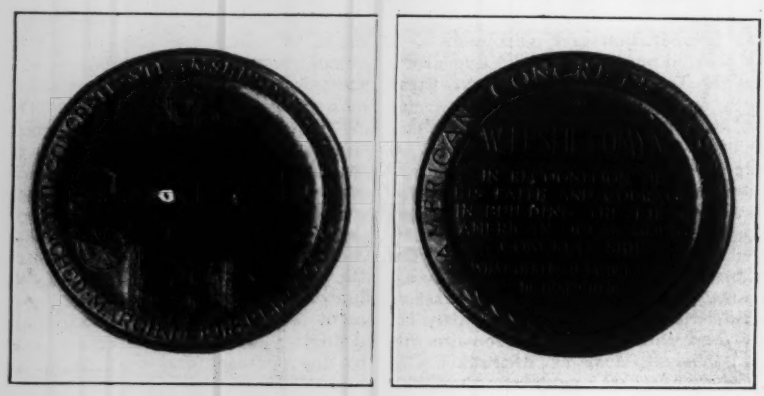
St. Paul Increases Tax Limit

As an aid to a readjustment of its finances to meet after-war conditions, the voters of St. Paul, Minn., have just approved a charter amendment which will permit city expenditures up to $30 per capita, instead of $24. The latter figure was fixed in 1914. Since then the per capita budget appropriations have been: $18.57; $20.75; $20.73; $22.02, and $23.85.

Imparting Accident Prevention Knowledge to Workmen

According to a booklet just issued by the Working Conditions Service of the United States Department of Labor, entitled "How To Give Illustrated Lectures on Accident Prevention to Workmen," it is stated that the most effective way is through the use of short talks of about 30 or 40 min. in length. These talks should be illustrated with slides and moving pictures showing the results of accidents rather than how to avoid them. Where the lectures are to be given to a large percentage of foreigners, they should be held at the noon hour in the dining room of the men, or, in the case of evening meetings, at 7.30 or 8 p.m. The evening meetings should be held at some central location and should be made an affair of interest to the workmen's entire families. The booklet mentioned, which may be obtained on request from the Department of Labor, gives a description of how to prepare addresses for delivery.

Presented to Builder of First Concrete Ship



MEDAL PRESENTED W. LESLIE COMYN, OF THE SAN FRANCISCO SHIPBUILDING CO., BY THE AMERICAN CONCRETE INSTITUTE, AT ITS CONVENTION AT ATLANTIC CITY, JUNE 28, 1919.

Selling Plan Announced by Fleet Corporation

Sale of all surplus and used property of the Emergency Fleet Corporation, including supplies, material and equipment, is to be carried on according to elaborate selling plans just announced. The items to be disposed of include manufacturing plants, shipyards, dry docks, ships completed and partly completed, yard equipment and material.

Requests for information concerning the items or conditions of sale should be directed to the U. S. Shipping Board office at Washington, with respect to completed ships; to the secretary's office, Emergency Fleet Corporation, Philadelphia, with respect to partially completed ships; to the Shipyard Plants Division of the Fleet Corporation at Philadelphia with respect to shipyards, dry docks, marine railways, and manufacturing plants; to the Transportation and Housing Division of the Fleet Corporation at Philadelphia with respect to housing and transportation projects; and to the Supply and Sales Division of the Fleet Corporation at Philadelphia or to the district supply and sales offices in New York, Philadelphia, New Orleans, Chicago and Portland with respect to all other materials. Foreign sales will be handled until the first of September by the American Steel Export Co., 233 Broadway, New York City, which has been awarded a contract for this service.

A sales review board has been established by the Fleet Corporation to study market conditions and fix or approve prices. Sales will be made by open bidding on advertised items or by purchase from the board's price lists. Efforts will be made to confine sales to those having actual use for the property, except in cases where sales for purposes of resale will not disturb market conditions. The Fleet Corporation will coöperate with other government departments and with the Chamber of Commerce of the United States in ascertaining market conditions. Open sales for items in excess of $5,000 must be approved by the sales review board.

It is stated to be the intention to move all property and material as quickly as possible consistent with the welfare of all interests involved. Proposed sales will be advertised widely, and it is also planned to circularize direct the firms and concerns that may appear to be possible buyers. Any persons or concerns interested in the sales may have their names placed upon mailing list to receive notice of all sales contemplated, upon request to the Shipping Board.

Large Sale of Steel Ships

Nineteen steel vessels were sold by the United States Shipping Board, recently. They range from 5350 to 9600 dead-weight tons' carrying capacity, and total 128,472 tons. The prices paid range from $210 to $225 per dead-weight ton, and amount to $27,821,120. Seven purchases are involved, one of them taking six of the vessels and another four. Of the 19 ships, 12 are fabricated.

With the sales noted, a total tonnage of 332,045 dead-weight tons, or 221,363 gross tons, of ships has been sold by the Shipping Board, for an amount exceeding $50,000,000.

Chicago Sanitary District Will Build 60 Miles of Road

Plans for a trunk highway about 60 miles long from Chicago to Waukegan and Joliet, Ill., along the right-of-way of the drainage canals are to be prepared under the direction of George Y. Wisner, chief engineer of the Sanitary District of Chicago. The type of construction is not determined, but large quantities of rock from the old spoil banks are available. From Chicago to Waukegan an 18-ft. road will suffice, but from Chicago to Joliet it is intended to have a width of 30 ft. in view of the possibilities of motor-truck traffic.

Observations by the National Service Committee

M. O. LEIGHTON, Chairman

PUBLISHER'S NOTE: The space occupied under the caption is donated to serve as a means of frequent and intimate communication between the Washington office of Engineering Council and the members of the profession. The contributor takes full authority for the statements made.

AN ENGINEER'S UNFORTUNATE EXPERIENCE AND THE WAR DEPARTMENT'S REPLY

A letter from a former engineer officer of the Army, resident in the Philippines, relating certain facts concerning his discharge from the Army at Washington, D. C., and his subsequent necessity for paying his own expenses back to the Philippines and of sustaining a loss of two months' time in transit, without compensation therefor, led to a letter of inquiry being sent by the National Service Committee to the Secretary of War. This has brought reply from the Chief of Engineers, U. S. A., to which is attached a copy of a memorandum sent by him to the Adjutant General in response to official reference from the latter's office. As this memorandum covers the case in a comprehensive and satisfactory way, it is quoted in part, as follows:

It appears that legislation is necessary before a satisfactory answer can be given to either of the questions raised in the letter from the Chairman, National Service Committee, Engineering Council.

Authority to pay mileage to first station is given in H.R. No. 100 introduced by Mr. Osborne on May 19, 1919. If passed, it will provide funds for the payment of mileage to officers commissioned in the National Army on joining their first station. It would remove the inequality now existing between officers in this class and officers in the Reserve Corps. In this connection attention is invited to memorandum from this office to the Legislation Branch of the War College dated Jan. 23, 1919, copy herewith. This memorandum explains in detail the circumstances under which about 800 Engineer officers were deprived of receiving mileage to their first stations although the same had been promised them.

The grounds for the complaint made in the second part of the letter quoted by Mr Leighton appear to be well taken. This matter was first brought to the attention of the Chief of Engineers by letter from Captain Harry D. Cranston, Engineers, dated Jan. 4, 1919, in which he requested that instead of being discharged at Camp Humphreys, orders be issued by the War Department directing his return to Manila, the place where he was ordered to active duty, and that he be discharged there. This request was forwarded to the Adjutant General by the Chief of Engineers, recommending approval. By Paragraph 4, Special Orders 16-0, Jan. 20, 1919, the War Department ordered him to proceed to Manila and report in person to the Commanding General, Philippine Department, for discharge.

Under date of Mar. 1, 1919, Captain John B. Findley, Engineers, who was ordered to active duty at Manila on the same order as Captain Cranston, requested orders to the Philippine Islands for discharge. This request was returned to the Chief of Engineers by the Adjutant General by 5th indorsement dated Mar. 18, 1919, stating that orders would issue directing Captain Findley to proceed to San Francisco for discharge and that "It is contemplated officers ordered to active duty outside the United States and who desire to return to their homes, will be discharged at the demobilization center in the United States nearest to their homes." This communication was returned to the Adjutant General by the Chief of Engineers by 8th indorsement inviting attention to the case of Captain Harry D. Cranston, but the Chief of Engineers was informed under date of Mar. 25, 1919, by 9th indorsement from the Adjutant General that here-

after the policy as stated above would be followed.

The criticisms voiced in this letter are evidently not without justification, and it is recommended that a draft of suitable legislation be submitted to Congress to correct, so far as the War Department can, the iniquities herein described.

(Signed) W. M. BLACK,
Major General, Chief of Engineers.

It is apparent from the memorandum above quoted that there are about 800 similar cases. The invitation given in our first communication on this subject, namely, that the former Engineer officers having had like experience should communicate with the National Service Committee, is here urgently repeated. It is obvious that Congress cannot be expected to take the time to pass corrective legislation if those in whose benefit it is proposed are too indifferent to relate the facts as they know them.

Grateful acknowledgment has been made to the reply of the Chief of Engineers above cited, and such assistance as the National Service Committee may properly give has been proffered. This committee can do nothing unless it has the coöperation of the engineers most interested in the matter.

Let Entire Water Front at Private Lease

Private control of the entire water front of the city of Berkeley, Calif., will be granted if a lease authorized by the City Council is completed. The lease was sold at auction and was granted to Rufus P. Jennings of Oakland, Calif., at a rental of $100 per month. An ordinance was thereupon passed by the City Council authorizing the lease. This will not become effective until July 24 and may be vitiated before that time by certain legal procedures. By the provision of the lease $1,000,000 must be expended on the leased premises and $2,000,000 on property adjacent to the leased land within the city of Berkeley. It is understood that plans are ready to provide for the building of a series of piers extending a long distance into the bay and carrying warehouses and industrial buildings. Under the terms of the lease Jennings is given a year in which to begin development work.

A. A. E. Committee on Engineers' Pay

An organization committee has been named by the American Association of Engineers to formulate a plan for promoting the non-technical interests of engineers in public service and to make a national study of proper pay for engineers. This is in line with a resolution adopted at the annual convention. The committee consists of F. H. Newell, president of the association; A. N. Johnson, consulting highway engineer for the Portland Cement Association; A. R. Hirst, state highway engineer of the state of Wisconsin, and S. C. Hadden, the editor of *Municipal and County Engineering*.

Chicago Smoke Problem Civic More Than Engineering

The pressing necessity of abating the smoke nuisance in Chicago was discussed, June 24, at a joint luncheon of the Western Society of Engineers and the City Club. That present ordinances are sufficient and need only proper enforcement was the opinion of Joseph Harrington, formerly of the United States Fuel Administration, who remarked that conditions are almost as bad as before the agitation for smoke abatement. Smoky plants discredit the designers and operators. Engineers agree that smokeless combustion of Illinois fuel can be accomplished and the matter involves civics, public sentiment and education rather than engineering.

A chief smoke inspector, who is an engineer thoroughly informed on combustion matters and who can present these to business men and boiler-room men, is indispensable, but the present salary is insufficient to attract such a man. The former smoke commission, composed of business men of high standing, was successful in getting results, and Mr. Harrington advocated its revival, together with a well organized city smoke-inspection department and a high-grade chief inspector.

Domestic consumption as a part of the problem was dealt with by Harold Almert, consulting engineer. Of the soft coal in Chicago, 85% is burned by industrial plants and 15% by domestic consumers, but this 15% of coal causes 70% of the smoke. There is plenty of Illinois coal suitable for domestic use, and it can be burned without smoke in furnaces, kitchen ranges and hot-water heaters. As a first step, Mr. Almert suggested the creation of a desire for civic cleanliness, which he estimated would save about $75,000,000 per year. The city's smoke-inspection department was not represented at the meeting.

Water Power Legislation Still Hangs Fire

Although water power bills have been introduced into the House and the Senate and although it was expected before this that at least the House bills would have been passed, the vote in each case has been postponed from time to time. There does not appear to be any immediate possibility of the passage of the bills.

Civil Service Examinations

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Assistant designing engineer, Naval Ordnance Plant, South Charleston, W. Va., $9.20 per diem. July 8. File applications before July 8.

Assistant inspector of engineering material (aircraft), $5.92 per diem, July 15. File applications before July 15.

Supervising draftsman, bureau of steam engineering, Navy Department, $12.80 to $13.60 per diem. Applications must be filed before August 19.

Chief ship draftsman, U. S. Navy Department, $10 to $12 per diem; draftsman, grade A, $8 to $9.60 per diem; draftsman, grade B, $6 to $7.20 per diem; draftsman, grade C, $5.20 per diem. No date specified. Applications should be filed without delay.

Chief draftsman, general engineering, architectural, power plant, heating and ventilating electrical, U. S. Navy Department, $10 to $12 per diem; draftsman, grade B, $6 to $7.20 per diem; draftsman, grade C, $5.20 per diem. No date specified. Applications should be filed without delay.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Master computer, $2400 to $1800 per year, computer (Grade I) $1800 to $1400 and computer (Grade II) $1400 to $900, Ordnance Department. Applications will be received until further notice.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 30, Oct. 1-3, Albany, N. Y.

The Engineers' Club of the Canal Zone held a meeting June 21 at Balboa Heights, C. Z. which was addressed by Harry F. Deitz, Bureau of Entomology, U. S. Department of Agriculture, who spoke on "Some Dangers in the Transporting of Plants from their Native Homes to Other Parts of the World."

The Colorado Association of Members of the American Society of Civil Engineers held its annual meeting June 14 at which the following officers were elected: President, W. C. Huntington; vice-president, Oliver T. Reedy, and secretary-treasurer, A. N. Miller.

The Union Pacific R.R. Section of the American Association of Engineers formed a permanent organization at a meeting held June 27, at which the following officers were elected: President, L. M. MacArthur; vice-president, C. W. Bivens; secretary and treasurer, J. G. True.

The Kansas City Engineers' Club held a meeting, June 27, which was preceded by an inspection trip to the

Turkey Creek Tunnel, which is driven through rock under Grey Stone Heights for the diversion of Turkey Creek, as the guests of the Raymond Concrete Pile Co. Over 100 members of the club made the inspection trip.

PERSONAL NOTES

LOUIS C. DUPUIS, assistant resident engineer, maintenance of way, Canadian National Railways, has been appointed division engineer, Saguenay division, with headquarters at Quebec. After a few years' experience in county engineering work he entered railroad service in 1910 on the construction of the National Transcontinental, and in 1911 was appointed assistant engineer, Intercolonial Railway, and later assistant resident engineer. In 1916 he was appointed assistant resident engineer, maintenance of way.

T. M. BOLE, assistant engineer, Pennsylvania Lines West, with headquarters at Pittsburgh, has been assigned the field work formerly handled by J. H. Minton, senior assistant engineer, resigned to enter the service of the United States Steel Corporation, as noted elsewhere.

CASIMIR S. GZOWSKI, JR., has been appointed special engineer to the vice president, Canadian National Railways, with headquarters at Toronto. He entered railroad work in 1897 in the construction department of the Canadian Pacific and remained in railroad construction work until 1914, when he entered private practice. He was appointed on the Royal Commission of Engineering Railways on valuation work.

JOHN H. LANCE, for the past 22 years chief engineer, Spring Brook Water Supply Co., Wilkes-Barre, Penn., has resigned to engage in private practice with offices in the Second National Bank Building, Wilkes-Barre. He will, however, retain a connection with the Spring Brook company in an advisory capacity.

L. P. STRUBLE, assistant engineer, Pennsylvania Lines West, with headquarters at Pittsburgh, has been assigned the office work previously handled by J. H. Minton, senior assistant engineer, resigned to enter the United States Steel Corporation, as noted elsewhere.

LIEUT. COL. GEORGE A. JOHNSON, Construction Division, U. S. A., whose association in partnership with Maj. W. L. Benham was recently announced in these columns, has been promoted to the rank of colonel. Colonel Johnson entered the service in the spring of 1918 as a major and was promoted to the rank of lieutenant colonel, November, 1918. He is now second in command of the Operation and Repair Branch of the Construction Division of the Army, which has charge of the operation and maintenance of camp utilities, including roads, railroads, buildings, water supply and sewage at the various army establishments.

MAJ. LYMAN GRISWOLD, Corps of Engineers, U. S. A., who served with the expeditionary forces in France, recently returned to this country and to civil life. He has opened offices in the Railway Exchange Building, Portland, Ore., to engage in practice as a consulting civil engineer.

A. M. BURT, assistant general manager, Northern Pacific R.R., has been appointed assistant director of the Division of Operation, United States Railroad Administration, with headquarters at Washington, D. C., in charge of engineering and maintenance, succeeding Charles A. Morse, who recently resigned to resume his former position as chief engineer, Chicago, Rock Island & Pacific Ry., as noted in a recent issue. Mr. Burt entered railroad service in 1885 as a rodman on the Colorado Midland, and a few years later became assistant engineer on the Northern Pacific and afterward on the Adirondack & St. Lawrence, the Wisconsin Central and the Chicago & Northwestern. In 1897 he reëntered the service of the Northern Pacific as supervisor of bridges and buildings, and four years later was appointed assistant superintendent. Until 1914 he served as superintendent of various divisions, and in 1918 became chief engineer, maintenance of way. He was then appointed acting general manager, Lines East of Paradise, Mont., and later became assistant general manager of the Eastern Lines with headquarters at St. Paul.

W. THOMAS WOOLEY, formerly city engineer of Auburn, N. Y., Hoosick Falls, Schenectady and Syracuse, has been appointed engineer in charge of construction of the new state prisons at Sing Sing and Wingdale.

W. F. MONFORT has resigned as acting professor of sanitary chemistry, University of Illinois, to resume private practice in the examination and treatment of water supplies, with offices at 506 N. Vandeventer Ave., St. Louis.

E. C. JOHNSON, acting chief engineer, Pacific Electric Railway, has been appointed chief engineer, with headquarters at Los Angeles, succeeding George E. Pillsbury, retired. The office of assistant chief engineer has been abolished.

J. H. MINTON, senior assistant engineer, Pennsylvania Lines West, has resigned to enter the service of the United States Steel Corporation with headquarters at Pittsburgh.

MAJ. H. B. HOMMON, Sanitary Corps, U. S. A., formerly in charge of water supply, Advance Section, A. E. F., recently returned to this country and received his discharge from the service. He will resume his former work with the United States Public Health Service, with headquarters at Cincinnati.

J. X. COHEN, who for the past year served as office engineer on the construction of the artillery cantonment at Camp Knox, Ky., has returned to his duties as designing engineer, Syracuse, N. Y., Intercepting Sewer Board.

ADOLPH JUDELL, for the past eight years engineer-member of the Board of Public Works of San Francisco, has resigned to become vice-president and general manager, Blanchard, Crocker & Howell Construction Co.

EARL STORER, 303rd Engineers, has received his discharge from the service and resumed his work in the engineering department of Mercer County, N. J.

RALPH ARNOLD, having completed his Government service, has resumed his practice as a consulting engineer, with offices in the Union Oil Building, Los Angeles, and at 120 Broadway, New York City.

W. L. BLACKMON, Montgomery, Ala., has been appointed assistant engineer, river plant, Montgomery waterworks, succeeding F. B. Jenkins, who died last May.

CHARLES E. HENDERSON, district engineer, United States Housing Corporation, has been appointed principal assistant engineer, with headquarters in Washington, D. C.

T. KEARNEY, assistant engineer, Canadian National Railways, Montreal, has been appointed resident engineer, Montreal division.

NELSON I. RAYMOND, Marshall, Mich., has been appointed city engineer of Owosso, Mich., succeeding E. S. Brewer, resigned.

WALTER FRICKSTADT has resigned as assistant city engineer of Oakland, Calif., to become a senior engineer, U. S. Bureau of Public Roads.

C. H. N. CONNELL, district engineer, Quebec district, Canadian National Railways, has been transferred from Montreal to Quebec.

W. G. TINNEY has been appointed division engineer, Colorado Division, Union Pacific R.R., with headquarters at Denver, succeeding C. M. Thompson, resigned.

OBITUARY

WILLIAM M. KNOELLER, contractor, Binghamton, N. Y., died Jun 16.

THOMAS N. HOOPER, president Davenport Water Co., Davenport, Iowa died in that city June 27.

Asphalt Association Service Department

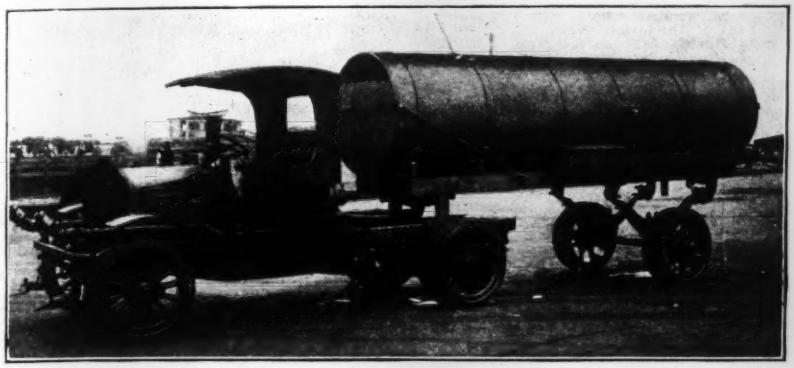
Details of the service to be rendered to public officials by the service department of the newly formed Asphalt Association have just been announced.

The idea of the association is that by raising the standard of asphalt work in all communities up to that attained by the most successful communities the interests of both the taxpayers and the asphalt industry will be materially benefited.

The names of the engineers forming the preliminary organization were given in the *Engineering News-Record* of June 26, p. 1286. They will work from the head office at 15 Maiden Lane, New York, and from branch offices in various parts of the country. Various lines of service have been proposed, among which may be named: (1) Coöperation with colleges and other educational institutions, through lectures and otherwise, to the end that the young engineer on graduation may have an accurate knowledge of the uses and limitations of asphalt; (2) a research department to coöperate with public officials in the selection of asphalt and the types of construction; (3) coöperation with officials in the proper construction of asphaltic roads; (4) collection and distribution of information of economic and statistical character.

New Semi-Trailer Sprinkler and Flusher With Detachable Tank

A new semi-trailer street sprinkler and flushing machine, as shown in the accompanying illustration, is being put upon the market by Charles Hvass & Co., of 511 E. 18th St., New York City. The avantages claimed for this apparatus are its extra tank capacity and the fact that the trailer may be detached and the truck used for other purposes.



SEMI-TRAILER STREET FLUSHER AS USED IN BUFFALO, N. Y.

A five-ton Pierce-Arrow truck is used for the motive power and support of the various sprinkling nozzles. The tank holds 2000 gal. and is attached to the truck through a plate bearing with motion in two directions, thus giving great flexibility. All the nozzles, of which there are four flat nozzles for flushing and two round nozzle sprinklers, are operated by levers from the driver's seat. Buffalo, N. Y., has six of these machines in operation and nine more ordered. In the winter the tank is detached and the truck is used for other purposes.

Business Notes

THE LAKEWOOD ENGINEERING CO., of Cleveland, Ohio, has engaged Lawrence L. Rogers, an experienced contractor, as plant service engineer, to render service and advice to contractors and public officials in solving construction plant problems on highway work. Mr. Rogers was formerly treasurer and field manager of Rogers Brothers Co., Los Angeles, Calif.

THE BLAW-KNOX CO., of Pittsburgh, Penn., announces that the sale of its plant located at Wheatland, Penn., is in line with its program to concentrate all of its manufacturing at Hoboken, Penn., where it is building a plant to take care of the work previously handled at Wheatland. The new plant at Hoboken will be completed within the next few weeks. A welding plant, in which steel mill and chemical plant specialties will be manufactured, is also being built at Hoboken.

THE ADVANCE MACHINERY CO., of 1234 Real Estate Trust Bldg., Philadelphia, Penn., announces that Alfred H. Wynkoop, formerly president of the Ralph R. Lewis Co., of Philadelphia, has severed his connection with that firm to become associated with the former company in a selling capacity. He will handle a complete line of contractors' roadmaking and railway equipment.

THE EDISON STORAGE BATTERY CO. announces the election of Maj. Charles E. Sholes as vice-president, director and general sales manager, succeeding Harrison G. Thompson, who has resigned to organize and conduct the Transportation Engineering Corporation of New York. Major Sholes has heretofore been identified with the construction, operation and management of chemical industries. He served in the war in the Ordnance Department, Chemical Branch, and is chairman of the Society of Chemical Industry.

THE HARRISON SAFETY BOILER WORKS announces that it has acquired the "Monash" line of pressure-reducing valves and pump governors formerly manufactured by the Monash-Younker Co., of New York, and will manufacture and market the valves under the trade name "Cochrane-Monash." Repair parts for valves now in use will also be furnished.

Trade Publications

The following companies have issued trade publications:

THE ACME MOTOR TRUCK CO., Cadillac, Mich.; folder, 9¼ x 11¾ in., 4 pages, illustrated; gives testimonials and costs of handling coal by motor trucks, including a 5-mile haul from mine to city.

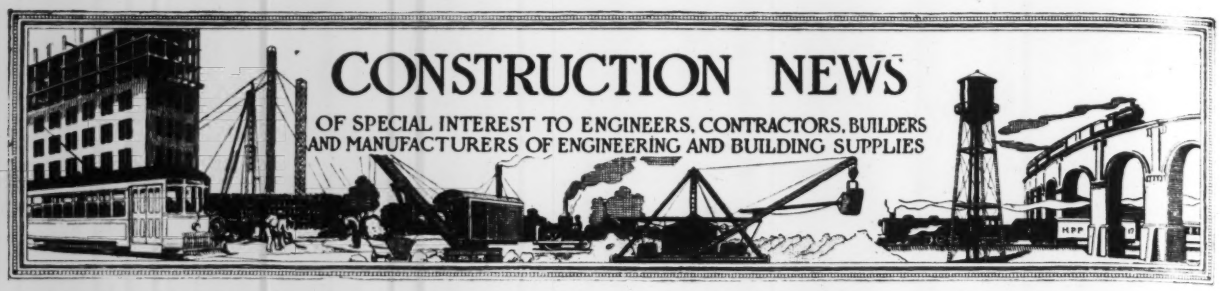
THE THOMPSON-STARRETT CO., New York City; book, 5½ x 8 in., boards, with linen back, illustrated; reproduces photographs of the Municipal, Woolworth, Equitable and other buildings in New York City and elsewhere constructed by the company, together with a brief descriptive text. The book is handsomely made and includes a view of the sky-line of New York City, showing a number of buildings, power houses, industrial plants and United States government works executed by the company.

THE INTERNATIONAL STEEL TIE CO., Cleveland, Ohio; folder, 8½ x 11 in., illustrated; describes the use of steel guards for edging for concrete paving.

THE WALLACE & TIERNAN CO., INC., New York City; catalog, 7 x 10 in., illustrated; the subject of the booklet is "Protecting the Water Supply of Greater New York." They have also issued a folder 8½ x 11½ in., 4 pages, illustrated; entitled "How Much is Three Billion Gallons?" Both describe sterilization of water by the use of liquid chlorine.

THE GENERAL CONSTRUCTION CO., of Chicago, Ill.; leaflet, 8½ x 11 in., one page, illustrated; describes a rivet forge.

THE GEORGE C. ZIDETTO MACHINERY CO., Pittsburgh, Pa.; folder, 9 x 12 in., 8 pages, illustrated; gives specifications and describes various kinds of concrete and material-handling machinery.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

"For Proposals Advertised see the pages immediately following the Construction News Section."

WATERWORKS

Bids Close		See Eng. News-Record
July 14	Mt. Pleasant, Utah	July 3
July 15	Denton, Mont.	June 19
July 16	Milwaukee, Wis.	June 26
July 16	Decorah, Ia. Adv. June 12 and 19.	June 12
July 19	Lincoln, Neb.	July 10
July 21	Eagle Rock, Cal.	July 10
July 21	Hinckley, Minn.	July 10
July 22	Ashland, O. Adv. July 10.	July 10
July 24	Ashland, Ky. Adv. July 10.	July 10
July 25	Akron, O. Adv. July 3.	July 3
Aug. 1	Litchfield, Minn.	July 3

SEWERS

July 14	North Mankota, Minn. Adv. June 19.	June 19
July 15	St. Cloud, Minn.	July 10
July 15	Newman Grove, Neb.	July 3
July 16	Milaca, Minn.	June 19
July 18	Goldsboro, N. C. Adv. July 10.	July 10
July 22	Bradley, Ill.	July 10
July 24	Harrison, Ont.	July 10
July 25	Milan, Mo.	July 10
Aug. 5	Wakefield, Neb.	July 10
Aug. 19	Kansas City, Mo. Adv. July 3.	July 3

BRIDGES

July 10	Adrian, Mich. Adv. June 26.	June 26
July 10	Riparius, N. Y. Adv. June 19.	June 19
July 14	Princeton, Minn.	June 19
July 14	Annapolis Royal, N. S.	July 3
July 14	Du Bois, Pa.	July 10
July 15	Crookston, Minn.	June 26
July 15	Cedar Rapids, Mich. Adv. June 19.	June 19
July 17	Pilkington, Ont.	July 10
July 18	Punxsutawney, Pa.	July 10
July 18	Summerville, Pa.	July 10
July 18	Watertown, N. Y.	July 10
July 21	Arkansas	July 10
July 21	Phoenix, Ariz. Adv. July 10.	July 10
July 22	Walker, Minn.	July 10
July 24	Beaufort, S. C.	July 10
July 25	Livingston, Mont.	July 10
July 25	Toston, Mont.	July 10
July 29	Jacksonville, Fla.	July 3
Aug. 4	Little Rock, Ark.	July 3
Aug. 19	Statesboro, Ga.	July 3
Aug. 20	Swainsboro, Ga.	July 3

STREETS AND ROADS

July 12	Kingston, Ont.	July 10
July 12	Columbus, Miss.	July 10
July 13	Galt, Ont.	July 3
July 14	Grand Rapids, Minn.	June 26
July 14	Fayetteville, W. Va.	June 26
July 14	Ivanhoe, Minn.	June 26
July 14	Cambridge, Minn.	June 26
July 14	Worthington, Minn.	June 26
July 14	Ebensburg, Pa.	July 10
July 14	Long Island, N. Y.	July 10
July 14	Long Island City, N. Y.	July 10
July 14	St. Paul, Minn.	July 10
July 14	Duluth, Minn.	July 10
July 14	Baird, Tex.	July 10
July 14	Ebensburg, Pa. Adv. June 26 and July 3.	July 3
July 14	Hollidaysburg, Pa. Adv. July 3.	July 3
July 14	Washington	July 3
July 14	Fayetteville, W. Va.	July 10
July 14	Clintonville, Wis.	July 10
July 15	Anacortes, Wash.	July 10
July 15	Utah	July 10
July 15	Santa Fé, N. M.	July 10
July 15	Huntington, W. Va.	July 10
July 15	Indiana Adv. July 10.	July 10
July 15	St. Louis, Mo.	June 26
July 15	Vermont	July 3
July 15	Huntington, W. Va.	July 3
July 15	Albany, Mo.	July 10
July 15	Rochester, Minn.	July 3
July 16	Wisconsin	July 10
July 16	Faribault, Minn. Adv. July 3.	July 3
July 16	Indianapolis, Ind.	July 3
July 16	Springfield, O.	June 19
July 16	Doylestown, O.	July 10
July 16	Brooklyn, N. Y.	July 10
July 16	Litchfield, Minn.	July 10
July 16	Ebensburg, Pa.	July 10
July 17	Lisbon, O.	July 10
July 17	Red Wing, Minn.	July 3
July 17	Boston, Mass.	July 3
July 17	Port Huron, Mich.	July 10
July 17	Wisconsin	July 10
July 17	Pittsburgh, Pa.	July 10
July 18	Caledonia, Ont.	July 10
July 18	Adrian, Mich. Adv. July 10.	July 10
July 18	Ohio	July 10
July 18	Quebec	July 10
July 18	Owen Sound, Ont.	July 10
July 19	Brainerd, Minn.	July 3
July 19	Fair Haven, Ill.	July 10
July 20	Litchfield, Minn.	July 3
July 21	Arkansas	July 10
July 21	Burbank, O.	July 10
July 21	Welland, Ont.	July 10
July 22	Rome, Ga.	July 3
July 22	New York	July 10
July 23	Bethany, Mo. Adv. July 10.	July 10
July 23	Quebec	July 10
July 25	St. Louis, Mo.	June 26
July 25	Kent, O. Adv. July 3.	July 3
July 25	Jersey City, N. J.	July 10
July 26	St. Joseph, Mo.	July 10
July 28	Junction City, Kan.	July 10
July 29	Pennsylvania Adv. July 10.	July 10
July 29	New York Adv. July 10.	July 10
July 30	California	June 19
Aug. 24	Denver, Colo.	July 10

EXCAVATION AND DREDGING

July 14	West Warren, Mass.	July 10
July 15	Wapello, Ia. Adv. June 26.	June 26
July 15	Marshalltown, Ia. Adv. June 26.	June 26
July 15	Chicago, Ill.	July 10
July 15	Sheboygan, Wis.	July 10
July 18	Owen Sound, Ont.	July 10
July 20	Columbus, Mont.	July 10
Aug. 6	Kenton, O.	July 3

INDUSTRIAL WORKS

Bids Close		See Eng. News-Record
July 12	Brooklyn, N. Y.	July 1
July 15	Omaha, Neb.	July 10
July 15	Flushing, N. Y.	June 19
July 15	London, Ont.	July 3
July 20	Omaha, Neb.	July 3
Aug. 1	Duluth, Minn.	June 26
Aug. 1	Hastings, Minn.	May 15

BUILDINGS

July 12	Sheboygan, Wis.	July 10
July 12	Sault Ste Marie, Ont.	July 10
July 12	Toronto, Ont.	July 10
July 14	Halifax, N. S.	July 10
July 14	Decatur, Mich.	July 3
July 15	Crookston, Minn.	July 3
July 15	Fraserville, Que.	June 12
July 15	Greybull, Wyo.	June 26
July 15	Ste. Annedes, Que.	July 10
July 15	Junction City, Kan.	July 10
July 15	Brainerd, Minn.	June 26
July 15	Detroit, Mich.	July 10
July 15	Hamtramck, Mich.	July 10
July 15	Harlowton, Mont.	July 10
July 15	Helena, Mont.	July 10
July 16	Hastings, Minn.	July 10
July 16	Wahjamego, Mich.	July 10
July 16	Oaklandon, Ind.	July 10
July 16	Centerville, Minn.	July 10
July 17	Malone, N. Y.	June 26
July 17	Thiells, N. Y. Adv. July 3.	July 3
July 18	Ivanhoe, Minn.	July 3
July 20	Salt Lake City, Utah.	July 10
July 21	Wellington, Kan.	July 10
July 22	Detroit, Mich.	July 10
July 23	Rock Hill, S. C.	July 10
July 23	Montmatre, Sask.	July 3
July 23	Lorain, O.	June 26
July 23	Mechanicsburg, O.	July 3
July 24	Winona, Minn.	July 3
July 24	Minneapolis, Minn.	July 3
July 24	Bemidji, Minn.	July 3
July 25	Salt Lake City, Utah.	July 10
July 28	Murray, Utah	July 10
July 28	Montreal, Que.	July 10
July 28	Shawenegan Falls, Que.	July 10
July 28	Woodstock, Ont.	July 10
July 28	Cap de la Madeleine, Que.	July 10
July 29	Utica, N. Y. Adv. June 26 and July 3.	July 3
July 29	Omaha, Neb.	July 10
July 30	Austin, Minn.	June 26
July 31	Lincoln, Neb.	July 10
Aug. 1	Gastonia, N. C.	June 26
Aug. 1	Kenosha, Wis.	May 15
Aug. 1	Duluth, Minn.	July 10
Aug. 1	Virginia, Minn.	June 19
Aug. 1	Duluth, Minn.	July 3
Aug. 5	Willmar, Minn.	July 3
Aug. 15	Casper, Wyo.	July 10
Aug. 15	New Bedford, Mass.	July 10
Aug. 15	Omaha, Neb.	July 10
Aug. 24	St. Paul, Minn.	July 3

FEDERAL GOVERNMENT WORK

July 15	Officers Quarters—Washington, D. C.	June 26
July 15	Officers Quarters—Wilmington, N. C.	June 26
July 16	School—Rapid City, S. D.	June 26
July 18	Silt Diversion Works—Los Angeles, Cal. Adv. June 19.	June 19
July 21	Dredging—New York, N. Y. Adv. June 26.	June 26
July 21	Dredging—Savannah, Ga. Adv. June 26.	June 26
July 21	Dredging—Baltimore, Md. Adv. June 26.	June 26
July 22	Dredging—Sault Ste Marie, Mich. Adv. June 26.	June 26

Bids Close		See Eng. News-Record
July 22	Post Office — Andalusia, Ala.	June 26
July 23	Cottage—Sorrento, Idaho.	June 26
July 23	Bridges—Leupp, Ariz.	June 26
July 23	Removing Wreck — New York, N. Y. Adv. June 26.	June 26
July 24	Jetty—Jacksonville, Fla. Adv. June 26.	June 26
July 24	Coal—Jacksonville, Fla. Adv. June 26.	June 26
July 25	Dredging — Philadelphia, Pa. Adv. June 26.	June 26
July 25	Post Office—Dawson, Ga.	July 10
July 25	Mechanical Equipment — Stapleton, N. Y. Adv. July 10.	July 10
July 25	Kitchen and Mess Hall—Stapleton, N. Y.	July 10
July 28	Stone—Cincinnati, O. Adv. July 3.	July 3
July 28	Dredging and Filling—San Juan, P. R. Adv. July 3.	July 3
July 29	Crib—Chicago, Ill.	July 10
July 30	Heating Apparatus — St. Augustine, Fla.	July 10
July 30	Dredgnig—New York, N. Y. Adv. July 10.	July 10
July 31	Boat House, Wharf and Boat Basin — Galveston, Tex.	July 10
July 31	Remodeling Elevator—Providence, R. I. Adv. July 10.	July 10
July 31	Storehouse — Wilmington, Del. Adv. July 3.	July 3
July 31	Rubble Mound Protection, etc.—Buffalo, N. Y.	July 10
Aug. 1	Dredging, Wharf and Retaining Wall — Boston, Mass.	July 10
Aug. 1	Lock and Dam—Cincinnati, O.	July 10
Aug. 2	Dredging and Rock Removal—Jacksonville, Fla. Adv. July 10.	July 10
Aug. 4	Sewers—Washington, D. C. Adv. July 10.	July 10
Aug. 7	Dredging and Rock Removal —New York, N. Y. Adv. July 10.	July 10
Aug. 26	Dredging—Honolulu, H. T. Adv. June 26.	June 26
Sept. 2	Miscellaneous Equipment—Washington, D. C. Adv. July 10.	July 10

MISCELLANEOUS

July 14	Road Gravel—Cambridge, Mass. Adv. June 12 and 19.	June 26
July 14	Fishway—Lawrence, Mass. Adv. July 3.	July 3
July 14	Gas Mains—Duluth, Minn.	July 10
July 14	Paving Materials—Staten Island, N. Y.	July 10
July 15	Wharf — Connaught Sta., Ont.	July 3
July 15	Freight and Trailers, etc.—New York, N. Y.	June 19
July 15	Wharf—Ottawa, Ont.	June 26
July 16	Pumping Engine—Milwaukee, Wis.	June 26
July 20	Breakwaters — Port Colborne, Ont.	July 10
July 22	Furnishings, Apparatus and Equipment—Albany, N. Y. Adv. July 10.	July 10
July 22	Wharf—Cornwall, Ont.	July 10
July 23	Wharf—St. Annede Beaupre, Que.	July 10
July 24	Wharf—Berthier, Que.	July 3
July 25	Wharf—Soaichton, B. C.	July 10
July 31	Wharf—Powell River, B. C.	July 10
July 31	Harbor Improvement—Atlantic City, N. J. Adv. July 10.	July 10

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Md., Baltimore—Bd. Awards rejected only bid received June 11, furnishing and erecting one 25 and one 15 k.w. turbo-generator set and switchboard for Mt. Royal Pumping Sta. W. E. Lee, City Hall, water engr. Noted May 22.

Fla., West Palm Beach—City having plans prepared by G. Simmons, Jr., c/o State Bd. Health, Jacksonville, building filtration plant. About $75,000.

O., Toledo—Standard Oil Co., E. O. Gas Bldg., Cleveland, having plans prepared for 15,000,000 gal. pumping plant, distribution and fire pressure system, also sewerage system, in 800 acre tract on Bay, here, to be used in connection with proposed new oil refineries. R. W. Pratt, Hippodrome Bldg., Cleveland, engr.

Minn., Wells—See "Industrial Works."

Kan., Phillipsburg—City voted $30,000 bonds to improve waterworks system. Engineer not selected.

Mo., Fairfax—City having plans prepared improving water and sewerage systems. About $40,000. Archer & Stevens, 609 New England Bldg., Kansas City, Mo., engrs.

Cal., Red Bluff—City having plans prepared by Olmsted & Gillelen, engrs., 1112 Hollingsworth Bldg., Los Angeles, for waterworks system.

Cal., Tracy—City voted $15,000 bonds to build water and sewer extensions. Noted June 26.

N. B., St. John — Nashwaak Pulp & Paper Co. plans to lay 9 mi. 12 in. rein.-con. water mains from Manchester Corners to Spruce Lake.

Ont., Smiths Falls—Town plans to build extension to waterworks system. About $11,514. J. A. Lewis, clk.

BIDS DESIRED

Ky., Ashland—Until July 24, by Bd. Water Comrs., building pumping station and filtration plant. Alvord & Burdick, 8 South Dearborn St., Chicago, Ill., engrs.; advertised in this issue.

O., Ashland—Until July 22, by R. A. Davis, dir. pub. serv., building filtration plant of 1,500,000 gal. capacity, and auxiliary pumping station with pumping equipment and necessary appurtenances. Contr. No. 1; 3375 ft. 24 in. and 5900 ft. 16 in. c.i. or rein.-con. pipe line, Contr. No. 2; storage reservoir consisting of earth dam and dikes, involving 47,000 yd. grading, concrete core wall, overflow and outlet chambers, pipe lines, gate valves, sluice gates, etc., Contr. No. 3. R. W. Pratt, Hippodrome Bldg., Cleveland, consult. engr.; advertised in this issue.

Minn., Hinckley—Until July 21, by R. N. Pearson, village clk., building distribution pipe system, involving 1880 lin.ft. 8 in. and 3390 lin.ft. 6 in. c. i. pipe, 13 fire hydrants and 11 gate valves, also building 100,000 gal. tank on 100 ft. tower. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, consult. engr. Noted June 19.

Neb., Lincoln—Until July 19, by T. H. Berg, city clk., building 16 x 193 ft. rein.-con. reservoir, 2,100,000 gal capacity. Work involves 1241 cu.yd. rein.-con. and 12,174 cu.yd. earth excav. About $33,000. G. W. Bates, city engr.

Cal., Eagle Rock—Until July 21, by B. B. Martsolf, city clk., furnishing deep well turbine pump of centrifugal runner type to have capacity of 350 gal. per min. on 125 ft. lift.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**N. Y., Poughkeepsie**—State Hospital Comn., Capitol, Albany, let contract building additions and altering water supply system to include additional filter, changing watermains, building reservoir, at Hudson River State Hospital, here, to Baker-Dunbar-Allen Co., Stock Exch. Bldg., Phila., Pa. About $52,000. Noted June 12.

N. J., Morris Plains—Dept. of Architecture, 142 West State St., Trenton, received only bid laying 6-10 in. water mains at State Hospital, here, from U. S. Cast Iron Pipe & Foundry Co., Morris Bldg., Phila., $10,000. Noted June 12.

★**Minn., Bemidji**—G. Stein, city aud., let contract extending and improving waterworks system, to Phelps-Drake Co., Hibbing, $30,852. Noted June 19.

★**Wyo., Lusk**—City let contract furnishing and installing 24,000 ft. 4-12 in. c.i. pipes, to Gordon Constr. Co., 334 Century Bldg., Denver, Colo., $72,512. Noted June 12.

★**Mont., Laurel**—City let contract extending water mains, 6 in. pipe, to Security Bridge & Constr. Co., 502 North 32nd St., Billings, $8841.

★**Mont., Roundup**—City let contract building water mains and hydrants in Impvt. Dist. No. 29, to Security Bridge & Constr. Co., 502 North 32nd St., Billings, $10,061. Noted May 8.

Idaho, Caldwell—City received lowest 3 bids replacing wooden water mains with c.i. mains, from Caldwell Plumbing & Heating Co., Caldwell, $27,958; Green Constr. Co., Salt Lake City, Utah, $27,926; J. H. Forbes Co., Caldwell, $28,069. Noted May 1.

Sewers

PROPOSED WORK

R. I., Providence—City soon receives bids building sewers in Magnolia, Delaware, Reservoir and Laurel Aves. and Freeman Pkway. About $75,000. M. D. Bronson, City Hall, city engr.

N. J., Morris Plains—Dept. of Architecture, 142 West State St., Trenton, rejected bids received June 26, building sewerage system at asylum here. About $10,000. Work will be readvertised. F. H. Bent, 142 West State St., Trenton, engr.

N. J., Trenton—City plans to build sewage disposal plant. About $500,000. J. R. Fell, 134 North Montgomery St., engr.

O., Dayton—City plans to build sewers in sections of Bway., Bancroft, Frizell, Reist, Summit and Frederick Sts., involving 4000 ft., 12-10 in. vitr. pipe. F. O. Eichelberger, city. engr.

O., Toledo—See "Waterworks."

Mich., Pontiac—City soon lets contract furnishing labor and material for building lateral sewers in Howard, Adelade, Harriet, Pingree, Francis, Ridge, Going, Edith, Elm and Osmum Sts., involving 12,212 ft. 8-12 in. pipe. C. W. Ham, city clk.

Wis., Janesville—Bd. Pub. Wks. soon lets contract building sewers in Center Ave., Galena and Holmes Sts., Sewerage Dist. No. 3, Franklin St., Dist. No. 4, Franklin St., and alley south of West Side Sta., Dist. No. 5, Hickory and Glenn Sts., Dist. No. 10, 4th Ave., Yuba, Walker and Glenn Sts., Dist. No. 11, North Bluff St., Dist. Dist. No. 11, North Bluff St., Dist. No. 12, Garfield and Ruger Aves., Walker and Ringold Sts., Dist. No. 14, Racine St. and Garfield Ave., Dist. No. 15, Vista Ave., N., and Sharon, Fremont and Carrington Sts., Dist. No. 16. Work involves 18,125 lin.ft. 8-15 in. sewer pipe, 48 manholes, etc. C. V. Kerch, city engr.

Wis., Sheboygan — C. U. Boley, engr., City Hall, soon lets contract excavating and laying 21 mi. sewer in South 9th St. from Clara to Union Ave., involving 3500 ft. 10-12 in. vitr. pipe, necessary water and gas connections, etc. About $22,000. Work to be completed by Oct. 1.

Ia., Strawberry Point—Town plans to build 1 mi. sanitary sewers and sewage disposal plant. H. R. Green, Union Blk., Cedar Rapids, engr.

Kan., Eldorado—City soon lets contract building sewers in Dists. 36 and 41. Work involves 22,400 ft. 8-12 in. vitr. pipe, 75 manholes, 6 flush tanks and 1 small pumping station with sewage pump. L. E. Foley, clk.

Wyo., Lusk—City voted $30,000 bonds to extend sewerage system. R. F. Gray, city engr.

Mo., Fairfax—See "Waterworks."

Tex., San Antonio—City election July 26 to vote on $500,000 bonds to build sewers. H. Helland, city engr.

Ore., Portland—City Council plans to build vitr. or cement pipe sewers in East 24th St., cost $3300, East 9th St., $2465, East 29th St., $1109; also plans to improve East 38th St., $1442, East Sherman St., $1512, and Oak St., $1691. O. Laurgaard, city engr.

Cal., Oakland—City soon lets contract building sewers and drainage structures on 8216.7 ft. 10th, Cedar, Goss and Bay Sts. and right-of-way adjacent to 7th St. About $240,000. P. Brown, city engr.

Cal., Santa Barbara—See "Streets and Roads."

Cal., Tracy—See "Waterworks."

BIDS DESIRED

N. C., Goldsboro—Until July 18, by I. M. Cashell, city mgr., building 7 mi. pipe sewers 8-12 in. diam., also furnishing sewer pipe; advertised in this issue.

Sewers (Continued)

Ill., Bradley—Until July 22, by Bd. Local Impvts., laying 40,000 ft. 10-48-in. vitr. tile pipe and brick sewers, involving 24,000 cu.yd. rock excav. About $70,000. Marr, Green & Co., 17 North La Salle St., Chicago, engrs.; advertised in this issue.

Minn., St. Cloud—Until July 15, by A. W. Buckman, city clk., laying 30 blocks 48 in. and 10 blocks 72 in. double ring or 2 piece vitr. segmental block sewers.

Minn., St. Paul—See "Streets and Roads."

Neb., Wakefield—Until Aug. 5, (change of date) by city clk., building 17,240 ft. of 8 in., 4943 ft. of 10 in., 3320 ft. of 12 in. and 1405 ft. 15 in. vitr. stone sewers in various streets. About $30,000. W. E. Standeven, 414 Bee Building., Omaha, engr.

Mo., Albany—See "Streets and Roads."

Mo., Milan—Until July 25, by city, building sanitary sewers and sewage disposal plant. About $40,00. Archer & Stevens, 609 New England Bldg., Kansas City, engrs.

Ont., Harrison—Until July 24, by W. D. McLellan, twp. clk., laying 17,932 ft. sewer.

PRICES AND CONTRACTS AWARDED
(★Indicates award of contract)

★**Pa., Meadville**—City let contract furnishing and laying 2 mi. 8 and 10 in. sanitary sewers, to T. Trifolletti, Loraine, Ohio, cost $1.25 per ft. for 8 in. and $2.50 per ft. for 10 in. pipe; pump station and two 200 gal. ejectors, to Keystone Constr. Co., Meadville. Noted May 15.

★**O., Braberton**—Dir. Pub. Serv. let contract building West End Sanitary Lateral Sewers to W. J. Irwin, Greenville. About $130,000. Noted June 19.

★**O., Springfield** — City let contract laying 12-24 in. vitr. pipe sewers in North Limestone St. from North to Columbia Sts., to M. S. Cooney, Springfield, $4823; Warder Park Addition, to J. Doyle, 935 Avondale Ave., $9780; Clay, Catherine, Linden and Rose Sts., to P. Caffrey, 609 Linden Ave., $7703. Noted June 26.

★**Mich., Birmingham**—City let contracts to Gilles & Hosmer, Pontiac, laying 600 ft. 8 in. and 238 ft. 6 in. sewer in Brown St., cost, $1198, 2130 ft. 8 in., 406 ft. 6 in. sewer, 40 ft. 8 in. c.i. pipe in Maple Ave., $3396; C. Mike, Pontiac, 800 ft. 8 in. and 369 ft. 6 in. sewer in Purdy St., $2177; C. Johnson, Pontiac, 1985 ft. 8 in. and 982 ft. 6 in. sewer in Southfield Ave., $4539; T. Evanoff, Pontiac, 1470 ft. 8 in. and 644 ft. 6 in. sewer in Pierce St., $3569. Noted June 26.

★**Kan., Pratt**—City let contract building sanitary sewers in Dist. No. 4, involving 23,400 lin.ft. 8 in. pipe, to Burt & Tripp, Hutchinson, $32,919. Noted June 19.

★**Mo., Macon**—City let contract building sewage disposal plant, to W. McClurken, 3807 Westminister Ave., St. Louis. About $16,000.

★**Que., Montreal** — City let contracts building sewers in Alexander and Girouard Aves., to De Keyser Wauters & Co., Montreal, $22,740; in Oxford Ave., to Federal Eng. & Contg. Co., Montreal, $10,785.

★**Ont., Ingersoll** — See "Streets and Roads."

★**Ont., Mimico**—See "Streets & Roads."

Bridges

PROPOSED WORK

Conn., Bristol—City plans to build 2 rein.-con. bridges, one on Main St., and one on Laurel St. About $25,000. Sperry & Buell, Inc., 175 Main St., engrs.

Va., Rectortown—Comrs. Fauquier Co. soon receive bids building 60 ft., cement concrete bridge over Goose Creek. Address D. D. Crenshaw.

N. C., Goldsboro—Wayne Co. plans to build 175 ft. steel and concrete bridge, 16 ft. wide. About $20,000. S. D. Scott, Goldsboro, engr.

Ga., Chatsworth — See "Streets and Roads."

Ill., Chicago—D. R. Francis, comr. pub. wks., 401 City Hall, receives bids about July 15, for substructure of 2 leaf rein.-con. bascule bridge over Chicago River on Madison St. Bids for superstructure to be called for later. Total cost $800,000. T. G. Pihlfeldt, bridge engr.

Wis., Sheboygan—G. Ubbelohde, engr., Court House, soon lets contract building 125 ft. steel bridge, 28 ft. wide, concrete abutements, in Herman Twp., involving 2900 lin.ft. wood piling and 3000-4000 cu.yd. earth approach and fill, cost $15,000; 490 ft. steel bridge, 30 ft. wide, in Mosel Twp., 4000 lin.ft. wood piling and 5000-6000 cu.yd. approach and fill, cost between $19,000 and $20,000.

N. D., Bismarck—Burleigh Co. plans to build bridge over Missouri River, here, to have three 400 ft. spans, filling and approaches, totaling distance of 5 mi. About $750,000. C. A. P. Turner, 627 1st Ave., N., Minneapolis, Minn., engr.

Tex., San Antonio—City election July 26 to vote on $200,000 bonds to build bridges. H. Helland, city engr.

Colo., Castle Rock — Comrs. Douglas Co. soon let contract building 16 ft. rein.-con. bridge near Tomah and 30 ft. rein.-con. bridge between Greenland and Larkspur, on Denver-Colorado Springs Rd. About $20,000. D. Stewart, Castle Rock, engr.

Wash., Richland—State Highway Bd., Olympia, rejected bids received June 23, building 190 ft. steel span bridge over Yakima River, near here, Benton Co. Noted June 19.

Wash., Spokane—City having plans prepared for 180 ft. concrete bridge over Hangman Creek, 35 ft. wide, with 5-6 ft. sidewalks. About $24,000. A. D. Butler, city engr.

N. B., Sackville—Canadian Natl. Rys. Ottawa, soon lets contract building substructure of double track bridge, with three 200 ft. spans, over Tantramar River, near here. About $125,000.

Ont., Markham—Town having plans prepared by James Loudon & Hertzberg, engrs., 36 Toronto St., Toronto, for 9 concrete beam culverts, 9 to 27 ft. spans. About $30,000.

Ont., Parry Sound—Town Council soon lets contract building Cascade Bridge, to have 2 steel spans, concrete abutments and center pier. About $15,000.

BIDS DESIRED

N. Y., Watertown—Until July 18, by city, building rein.-con. bridge over Black River on Pearl St. Concrete Steel Eng. Co., 21 Park Row, New York City, engrs. Noted July 3.

Pa., Du Bois—Until July 14, by city, building 104 ft. bridge on Brady St., 46 ft. wide. G. A. Flink, 301-303 Commonwealth Trust Bldg., Harrisburg, engr.

Pa., Punxsutawney—Until July 18, by Jefferson Co., Brookville, building 48 x 148 ft., rein.-con. bridge, here. G. A. Flink, 301 Commonwealth Trust Bldg., Harrisburg, engr.

Pa., Summerville—Until July 18, by Jefferson Co., Brookville, building 48 x 182 ft., rein.-con. bridge, here. G. A. Flink, 301 Commonwealth Trust Bldg., Harrisburg, engr.

S. C., Beaufort—Until July 24, by Comrs. Beaufort Co., setting 6 rein.-con. piers under 500 ft. steel girder bridge over Whale Branch, tearing out wooden piling and concreting steel caisson turn pier, involving 550 cu.yd. rein.-con. and 3.9 tons reinforcing steel. About $13,000. J. R. Pennell, c/o State Highway Dept., Columbia, engr.

Minn., Walker—Until July 22, by C. D. Bacon, aud. Cass Co., building bridge No. 3070 on Highway No. 24, 710 ft. long. About $15,000. A. W. Moulster, Pine River, engr.

Mont., Huntley—Until July 25, by State Highway Comn., Helena, building 950 ft. bridge over Yellowstone River, Huntley Twp., Yellowstone Co., 16 ft. wide, consisting of five 190 ft. steel spans on concrete piers and abutments. P. D. Pratt, state highway engr. Noted Mar. 20 under "Billings."

Mont., Livingston—Until July 25, by State Highway Comn., Helena, building Carter Bridge over Yellowstone River, near here, Park Co., 270 ft. long, 16 ft. wide, consisting of 3 span concrete arch. P. D. Pratt, state highway engr. Noted Mar. 13.

Mont., Toston—Until July 25, by State Highway Comn., Helena, building 529 ft. steel bridge over Missouri River, 16 ft. wide, Broadwater Co. P. D. Pratt, state highway engr.

Arkansas—Until July 21, by Comrs. Helena-Old Town Rd. Impvt. Assn., at office of State Highway Comn., Little Rock, building one 30 ft. steel and one 645 ft. wooden bridge, 30 ft. wide, in Phillips Co. J. M. Quarles, Helena, engr.

Ariz., Phoenix—Until July 21, by T. Maddock, state engr., building 120 ft. rein.-con. arch bridge over Queen Creek on Mesa-Superior Highway; advertised in this issue.

Ont., Pilkington—Until July 17, by S. Aitcheson, engr., Elora, building steel bridge, 75 ft. long, over Grand River, with concrete abutment.

PRICES AND CONTRACTS AWARDED
(★Indicates award of contract)

★**R. I., Washington**—State Bd. Pub. Rds. let contract building rein.-con. bridge on Noose Neck Hill Rd., here, to Randall-Stoddard Co., Chelsea, Mass. About $18,450.

Conn., New Haven—City received bids building bridge over West River on Washington Ave., rein.-con., concrete, steel and stone, from C. W. Blakeslee & Sons, 58 Waverly St., $66,941; C. W. Murdock, 185 Church St., $67,040; C. A. Sibley, 902 Chapel St., $77,808. Noted May 1.

Conn., New Haven—City received bids repairing Neck Bridge on State St., rein.-con. and steel, from C. W. Blakeslee & Sons, 58 Waverly St., $21,606; C. A. Sibley, 902 Chapel St., $21,932; C. W. Murdock, 185 Church St., $23,881. Noted Feb. 13.

★**Pa., Leetsdale**—Comrs. Allegheny Co. (Pittsburgh) let contract building 100 ft. stone and concrete bridge, with 37 ft. arch, over Sewickley Creek, between Allegheny and Beaver Counties, 50 ft. wide, to E. W. Falck, Leetsdale, $48,500. Work involves 9000 lbs. dowels and reinforcement steel, 1100 cu.yd. earth approach and fill, 500 cu.yd. masonry in foundations and 1250 cu.yd. masonry above foundations. Noted June 19.

★**Minn., Litchfield**—Comrs. Meeker Co. let contract building Bridges Nos. 3116 and 3117 on State Rd. No. 6, Federal Aid Project No. 40, to Guaranty Constr. Co., 834 Palace Bldg., Minneapolis, $12,290. Noted June 12 under "Streets and Roads."

★**Ont., Orangeville**—Town let contract building 40 ft. rein.-con. arch bridge over Grand River, to J. Tilker, Harriston. About $21,000.

★**Ont., Pickering**—Provincial Government, Toronto, let contract building 150 ft. steel span bridge, here, to Dominion Bridge Co., Imperial Life Bldg., Toronto. About $100,000.

Reinforced Concrete

PROPOSED WORK

Ont., Markham—See "Bridges."

BIDS DESIRED

Pa., Pittsburgh—See "Industrial Works."
Minn., Rochester—See "Buildings."

PRICES AND CONTRACTS AWARDED
(★Indicates award of contract)

★**Pa., Johnstown**—See "Industrial Works."
Minn., Russell—See "Buildings."
★**Ont., Orangeville**—See "Bridges."

Streets and Roads

PROPOSED WORK

R. I., Providence—City soon receives bids paving Union, Pocasset and Kinsley Aves. and Delaware St., asphalt. About $70,000. M. S. Bronson, City Hall, city engr.

Conn., Wallingford—Town plans to improve State Rd., asphalt. About $20,000. W. A. MacKenzie, engr.

N. Y., Rochester—City Council plans to grade and build walks on 13th St., cost $14,300, and Morrill St., $8700, pave Tryon Park, $32,750, Averill Ave., $23,400, Dartmouth St., $18,600, De Neve St., $82,400, Main St., E., from Culver to Winton Rds., $133,000, Clifford Ave., $4700, all asphalt; traprock resurfacing with Tarvia, University Ave., $10,600, building walks on Genesee St., $1460, also extending McArdle St., $1000, McGuckin St., $2500 and Handy St., $2500. C. A. Poole, city engr.

N. J., Bogota—City plans to improve Cane St. from Leonia Ave. to Borough line. About $10,000.

N. J., Jersey City—City had plans prepared paving Baldwin Ave., from Pavonia to Newark Aves., asphalt, cost, $10,000; improving Jackson Ave. from Fulton to McAdoo Aves., probably granite block. C. A. Van Keuren, city engr.

Streets and Roads (Continued)

Pa., Butler—City rejected bids paving 1152 sq.yd. Oak St., 1365 sq.yd. Summit St., 6915 sq.yd. Jefferson St., 1917 sq.yd. Wayne St. and 4175 sq.yd. Center Ave. Noted May 22.

Pa., Clarksville—Boro. rejected bids received June 10 laying 1300 lin.ft. waterbound macadam and one course concrete pavement. Noted Apr. 3.

Pa., Pittsburgh—Allegheny Co. Controller soon lets contract building 2000 ft. Troy Hill Rd., Reserve Twp., 16 ft. wide, Telford macadam. A. V. Warren, co. engr.

Pa., Reading — City rejected bids for 9000 sq.yd. vitr. brick pavement. Work has been re-advertised and contract will soon be let. Noted June 12.

Md., Baltimore—City Council considering ordinance providing for appropriation of $150,000 for enlargement of City Springs Sq., 350 x 400 ft., bounded by Spring, Caroline, Pratt and Lombard Sts. Buildings to be razed, lot regraded and cement paving.

W. Va., Lewisburg — Comrs. Greenbrier Co. plan to grade 6 mi. Ft. Springs-Ronceverte Rd. About $45,000. F. Rader, Lewisburg, engr.

W. Va., Lewisburg—Comrs. Greenbrier Co. plan to build 2 mi. road, from Lewisburg to Frankford, bituminous macadam. About $35,000. R. B. Holt, co. engr.

W. Va., Morgantown — Monongalia Co., Grant Dist., voted $325,000 bonds to build 19 mi. roads, vitr. brick. L. Cox, Morgantown, engr. Noted June 12.

W. Va., Pineville—Comrs. Wyoming Co. plan election soon to vote on $94,000 bonds to grade 4 mi. Elmore-Herndon Rd.

W. Va., Spencer—Comrs. Roane Co. plan election soon to vote on $67,000 bonds to improve 7½ mi. roads in Ready Dist. H. R. Muldoon, Spencer, engr.

N. C., Durham — Durham and Orange Counties plan to build 8 mi. Durham-Chapel Rd. About $300,000. Five different kinds of hard surface material will be used, plans being for an experimental roadway. State and Federal Government will appropriate toward cost. W. L. Fallis, c/o State Highway Comn., Raleigh, engr.

N. C., Elizabeth City—Comrs. Pasquotank Co. rejected bids paving 9 mi. road from here to Weeksville Rd., 15 ft. wide. Noted July 3.

N. C., Greensboro — City soon lets contract paving various roads, involving 80,000 sq.yd. asphalt on concrete base and 10,000 sq.yd. asphalt on macadam base. W. B. Bandy, city engr.

N. C., Mocksville—Comrs. Davie Co. plan to build roads. Cost between $50,000 and $100,000.

Ga., Blairsville—Union Co. voted $60,000 bonds to build roads. Federal Government will appropriate like amount.

Ga., Chatsworth—Murray Co. election July 16 to vote on $100,000 bonds to build roads and bridges.

Ga., Sylvester—Worth Co., voted $400,000 bonds to build roads. Noted May 22.

Miss., Ashland—Benton Co voted $200,000 bonds to build roads.

Miss., Columbus—City voted $50,000 bonds to pave streets in business section. R. M. Waters, city engr.

O., Akron—Summit Co. soon lets contract building 3.89 mi. Arlington-Greensburg Rd., Sect. 4, A and B; 2.37 mi. North Springfield Rd., and 3.01 mi. Brittain-Massillon Rd., Sect. A and B-1, brick, rein.-con. or bituminous concrete. C. J. Costigan, co. engr.

O., Columbus—City plans to grade, curb, pave and lay water mains in alley north of Norwich Ave. from High St. to Indianola Ave., 1890 ft. long, 20 ft. wide, brick or asphalt, cost $17,237; also alley north of Menlo Pl. between Taylor and Parkwood Ave., 740 ft. long, 15 ft. wide, brick or asphalt. H. A. Maetzel, city engr.

O., Dayton—City plans to pave Carlisle Ave. from St. Charles to Demphle Sts., 30 ft. wide, involving 2700 sq.yd. waterbound macadam, 8000 sq.ft. cement sidewalk and 1600 ft. cement curbing, cost $3527; (b) 3rd St. from west corporation line to point 1708 ft. west, 36 wide, 6800 sq.yd. brick block, $52,017; (c) alley east of Main St., 16 ft. wide, 500 sq.yd. granite durax or wood block, $1942. F. O. Eichelberger, city engr.

O., Oakwood — City plans to pave 2000 ft. Forrer Rd. from Far Hills to Oakwood Ave., 30 ft. wide, wood block, concrete or bituminous macadam. Cost between $25,000 and $40,000. P. Seybold, 504 Ludlow Bldg., Dayton, engr.

Ill., Chicago—Forest Preserve Comrs. of Cook Co. soon let contract grading and paving 4732 ft. Carpenter Rd. from Elston Ave. to city limits, 18 ft. wide. About $30,000. W. D. Flavin, County Bldg., engr.

Wisconsin—State Highway Comn., Div. Office No. 6, Eau Claire, soon lets contract improving Mondovi-Durand Rd. Federal Aid Project No. 78, Pepin Co., involving .31 acres clearing and grubbing, 9540 cu.yd. earth and 740 cu.yd. borrow excav., 120 cu.yd. class A concrete, 13,138 sq.yd. gravel surfacing etc.

Wis., Kiel—City soon lets contract grading and paving ½ mi. Main St., 18 ft. wide, 2 course rein.-con. Cost between $30,000 and $40,000. F. Muth, City Hall, engr. Noted June 19.

Ia., Strawberry Point — Town having plans prepared by H. R. Green, engr., Union Blk., Cedar Rapids, paving 2½ mi. and curbing and guttering 4½ mi. streets.

Kan., Independence—Montgomery Co. soon receives bids building 1½ mi. South Coffeyville Rd., 4½ mi. Coffeyville-Edna Rd., 10 mi. Cherryville-Coffeyville Rd. and 10 mi. Ozark Trail, 18 ft. wide, gravel or bituminous concrete, concrete curbing and guttering. H. K. Hibbard, Independence, engr.

Kan., Kinsley—City soon lets contract for 18,800 sq.yd. vitr. brick paving, 8000 lin.ft. concrete curbing and 8000 lin.ft. concrete guttering. G. W. Ellis, Pratt, engr.

Kan., Mound City—Linn Co. having plans prepared building 28½ mi. Jefferson Highway, 18 ft. wide, concrete or waterbound macadam. J. M. Mumbell, Mound City, engr.

Neb., Omaha—Douglas Co. plans to pave 115 mi. roads throughout county, brick on 6 in. concrete base. About $5,000,000; $3,000,000 of which has already been voted, $1,000,000 to be received from state and $1,000,000 from Federal Government. First work will be paving of Lincoln Highway, O. L. D. Rd. south to Gretna and Washington Highway north of Florence. L. A. Adams, Court House, engr. Noted May 22.

Neb., Superior—L. L. Carpenter, city clk., soon lets contract paving 20 blocks streets, 25 ft. wide, involving 25,000 sq.yd. asphaltic concrete on 5 in. concrete base or alternate bids on 6 in. concrete, and 15,000 lin.ft. concrete curb and gutter. About $75,000. A. A. Cummins, Superior, engr.

Montana—State Highway Comn., Helena, rejected bids received May 14 for road work in Dawson and Carbon Counties.

Montana—State Highway Comn., Helena, plans to pave 5.5 mi. Yellowstone Trail, Gallatin Co., cost $148,154, grade 23 mi. County Rd. No. 1, Meagher Co., $45,900; 24 mi. Plains-Hot Springs Rd., Saunders Co., $20,000; 6 mi. Goose Hill Rd., Choteau Co., $10,000; 11 mi. Edwards-South Rd., Choteau Co., $10,000; 35 mi. Jordan-Miles Rd., $16,000, 6 mi. Sand Springs-Sumatra Rd., Garfield Co., $10,000; 23 mi. Horse Creek Rd., $20,000, 15 mi. Sand Creek Rd., McCone Co., $18,000; gravel surface 10 mi. Avon-Finn Rd., Powell Co., $30,000; 35 mi. Yellowstone Trail, Yellowstone Co., $150,000; 8 mi. Pumpkin Creek Rd., $20,000, 6 mi. Miles-Ismay Rd., $20,000, 8 mi. Jordan Rd., $20,000, 10 mi. Yellowstone Trail, Custer Co., $30,000. Federal Government asked to appropriate toward cost. P. D. Pratt, state highway engr.

Mont., Big Timber—Sweetgrass Co. election Sept 2 to vote on $125,000 bonds to build roads. D. J. Walwoord, Big Timber, engr.

Mont., Bozeman—City soon lets contract bithulithic paving, curbing and grading, 7200 sq.yd. 7th Ave. from Main to Lamme Sts. and Lamme St. from 5th to 7th Aves., also 3720 sq.yd. College St. from 8th to 11th Sts. C Widener, city engr. Noted June 5.

Mont., Broadus — Powder River Co. election Sept 2 to vote on $150,000 bonds to build roads. F. L. Funkenbusch, Broadus, engr.

Mont., Chinook — Blaine Co. election Sept. 2 to vote on $100,000 bonds to build roads. C. R. Hanke, Chinook, engr.

Mont., Choteau—Teton Co. election Sept. 2 to vote on $150,000 bonds to build roads. F. Daly, Choteau, engr.

Mont., Columbus—Stillwater Co. election Sept. 2 to vote on $163,000 bonds to build roads. G. N. Cardoza, Columbus, engr.

Mont., Forsyth—Rosebud Co. election Sept. 2 to vote on $100,000 bonds to build roads. P. D. Pratt, c/o State Highway Dept., Helena, engr.

Mont., Harlowton — Wheatland Co. election Sept. 2 to vote on $200,000 bonds to build roads. C. C. Jewell, Harlowton, engr.

Mont., Harve—Hill Co. election Sept. 2 to vote on $150,000 bonds to build roads. J. E. Peterson, Harve, engr.

Mont., Philipsburg—Granite Co. election Sept. 2 to vote on $150,000 bonds to build roads. E. B. Patten, Philipsburg, engr.

Mont., Red Lodge — Carbon Co. election Sept. 2 to vote on $100,000 bonds to build roads. A. B. Cooley, Red Lodge, engr.

Mont., Shelby—Toole Co. election Sept. 2 to vote on $200,000 bonds to build roads. H. B. Rawson, Shelby, engr.

Mont., Thompson Falls—Sanders Co. election Sept. 2 to vote on $75,000 bonds to build roads. T. Johnston, Thompson Falls, engr.

Mont., Virginia City—Madison Co. election Sept. 2 to vote on $150,000 bonds to build roads. C. C. Adams, Virginia City, engr.

Tex., De Leon—City election July 15 to vote on $750,000 bonds to build permanent roads.

Tex., Ft. Worth—Tarrant Co. election July 26 to vote on $3,500,000 bonds to build highways. H. P. Hays, c/o Hess & Skinner, Southwestern Life Bldg., Dallas, engrs.

Tex., Hallettsville—Lavaca Co. voted $200,000 bonds to build highway from Schulenburg to here and from Sweet Home to Yoakum.

Tex., Linden—Comrs. Cass Co. plan to improve 13.23 mi. Highway No. 1-A from point near Queen City to Sulphur River, 16 ft. wide, including building iron ore gravel surfaced road and necessary drainage structures. About $75,000. Hess & Skinner, Southwestern Life Bldg., Dallas, engrs.

Tex., Montague—Montague Co. soon lets contract grading, gravel surfacing and building concrete bridges and culverts on 9.84 mi. Meridian Highway, State Highway No. 2, 16 ft. wide, involving 9353 cu.yd. earth, 1129 cu.yd. loose rock, and 45,482 cu.yd. borrow excav., 16,363 lbs. reinforcing steel and 345 cu.yd. classes A, B, C, concrete. About $101,323. J. R. Hill, Bowie, engr. Noted May 22.

Tex., San Antonio — City election July 26 to vote on $950,000 bonds to widen and open streets, $900,000 to pave same and $50,000 to build sidewalks. H. Helland, city engr.

Okla., Enid—City soon lets contract paving 22,000 yd., concrete. B. F. Lewis, city engr.

Colo., Denver—City soon lets contract surfacing 82,000 sq.yd. in North Denver Surfacing Dist. No. 5, slag, sand and loam; paving 9 blocks in 14th Ave. Paving Dist., asphalt; grading, curbing and building sidewalks in North Denver Impvt. Dist. No. 30. Cost $40,000, $45,000 and $80,000 respectively. J. B. Hunter, city engr.

Idaho, Troy — City voted $125,000 bonds to build and improve roads here.

Nev., Carson City—Comrs. Mineral Co. plan to build 10 mi. Walker Lake Rd. About $148,000.

Wash., Aberdeen—Bd. Pub. Wks. rejected bids received June 20, building concrete sidewalks on Grant, E, Market and Chicago Aves. Work will be readvertised. A. H. Blood, city engr.

Wash., Vancouver—City soon lets contract paving and building concrete curbing and sidewalks on 22nd St. from Main to Reserve Sts., 30 ft. wide, bituithic concrete or asphaltic concrete. W. Schwarz, city engr. Noted July 3.

Oregon—State Highway Comn., Portland, soon lets contract grading and paving 3.4 mi. Canyon Rd. from Beaverton to county line, Washington Co., involving 19,000 cu.yd. excav.; 13.1 mi. Dallas-Salem Rd., Polk Co., 40,000 cu.yd. excav., bituithic or concrete; ½ mi. Seufert Sect. Columbia River Highway, Wasco Co., 6800 cu.yd. excav.; grading and macadamizing 7.9 mi. Yamhill-Gaston Rd., Yamhill Co., 29,000 cu.yd. excav.; 700 ft. Comstock Overhead

Streets and Roads (Continued)

Crossing, Douglas Co., 300 cu.yd. macadam, 173 cu.yd. concrete, 5750 cu.yd. excav.; grading 6.3 mi. Oregon City-Oswego Rd., Clackamas Co., 37,500 cu.yd. excav., paving 4.2 mi. Salem-Brooks Sect. Pacific Highway, Marion Co.; 10.5 mi. Clatskanie-Westport Sect. Columbia River Highway, Columbia Co., bitulithic or asphaltic concrete; 8 mi. Svensen-Rock Creek Sect. Columbia River Highway, and 9.5 mi. Rock Creek-Westport Rd., both Clatsop Co., concrete or bitulithic; macadamizing 2.5 mi. Stage Rd. Pass Sect. Pacific Highway, Douglas Co., 5250 cu.yd. macadam. H. Nunn, Salem, state highway engr.

Oregon—State Highway Comn., Portland, soon lets contract paving 6.1 mi. Unit 1 and 6.1 mi. Unit 2, Eugene-Junction City Rd., Lane Co., bitulithic or concrete. H. Nunn, Salem, state highway engr. Noted June 26.

Oregon—State Highway Comn., Portland, soon lets contract grading and macadamizing 7.7 mi. Yoncalla Sect. Pacific Highway, Douglas Co., involving 10,000 cu. yd. excav. and 16,000 cu.yd. macadam. Noted June 26.

Oregon—State Highway Comn., Portland, soon lets contract grading and gravelling 16.7 mi. Central Oregon Highway from Burns to Lawen, involving 95,000 cu.yd. earth and rock excav. and 15,400 cu.yd. gravel; grading 4.4 mi. road from Baker to Cornucopia, 50,000 cu.yd. earth and rock excav.; grading 49 mi. John Day Highway from Dayville to Fossil, 359,000 cu.yd. earth and rock excav. H. Nunn, Salem, state highway engr.

Ore., Marshfield—City Council received no bids June 25, paving and building sidewalks on Vernon Ave. O. Laurgaard, city engr.

Ore., Marshfield—City Council plans to pave (a) Jerome Ave., 36 ft. wide, 1½ in. rock asphalt on 6 in. concrete base, (b) 4th St., 26 ft. wide, 1½ in. rock asphalt on 5 in. concrete base or 6 in. concrete, with parkway 5 ft. wide and 6 ft. concrete sidewalks. Total estimate on rock asphalt on concrete base, $49,448; concrete, $46,471. E. K. Burton, city engr.

Ore., Ontario—City Council plans to pave 3 mi. Oregon St. and side branches, and California Ave. from Oregon St. to city limits, asphaltic concrete or bitulithic. Cost to exceed $10,000.

Ore., Portland—City soon lets contract paving 72nd, 61st, 77th, East 33rd, East Madison and Ramona Sts. and Vernon Ave., asphaltic concrete on crushed rock base, concrete Nos. 1 and 2, concrete curbing and artificial stone or asphaltic concrete sidewalks. Cost to exceed $10,000. O. Laurgaard, city engr.

Cal., Chula Vista — City rescinded contract let to Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, building 4 mi. road. Legality of proceedings has been questioned by property owners. Noted June 5.

Cal., Oakland—City plans to improve 1000 ft. 38th Ave., involving 52,850 sq.ft. grading, 2030 lin.ft concrete curbing, 6237 sq.ft. concrete gutter, 3934 sq.yd. oil macadam pavement and 107 lin.ft. 8-24 in. corrugated iron and concrete culvert. P. Brown, city engr.

Cal., Oakland—City plans to grade, curb, gutter and pave 23rd and 29th Aves. About $60,000. Work involves 6258 lin.ft. concrete curbing, 7594 sq.ft. brick gutter, 1442 ft. 10-21 in. pipe conduit and 14,413 sq.yd. asphalt paving. P. Brown, city engr.

Cal., San Jose—Comrs. Santa Clara Co. had plans prepared paving 3 mi. and grading 10,000 ft. on Rodfish Mill Rd. J. Ryder, co. surv.

Cal., Santa Barbara—H. L. Hitchcock, 1919 De la Vina St., et al, plans to subdivide 350 acres between Riviera and Mountains into residential lots and build gravel streets, concrete curbs and gutters, cement sidewalks and sewers. About $50,000.

Cal., Taft—City had estimates prepared by E. M. Lynch, engr., Central Bldg., Los Angeles, for 92,000 sq.ft. macadam paving 1,220,000 sq.ft. grading, oiling and screening surfacing, 52,910 lin.ft. cement curbs and 234,000 sq.ft. cement walks. About $230,000.

Cal., Tracy—City voted $15,000 bonds to pave street intersections. Noted June 26.

Que., Chateauguay—Town soon receives bids building 2½ mi. macadam road from New York Central R.R. Bridge to Chateauguay limits. About $10,000. E. Laberge, clk.

Que., Greenfield Park—Town voted $20,000 by-law to build 8½ mi. macadam roads and ditch same, G. Reakes, St. Lambert, engr.

Ont., Exeter—Town Council plans to expend $25,000 to pave streets. J. Senio, clk.

Ont., Owen Sound—Town Council plans to expend $300,000 to build roads. D. H. Fleming, town engr.

Ont., Toronto — Bd. Wks. recommended that Gilmour and Skipper Aves. and Northcliffe Blvd. be paved. Work involves 12,000 sq.yd. bitulithic pavement on 6 in. concrete base, concrete curbing and guttering. About $49,239. R. C. Harris, City Hall, engr.

Ont., Toronto—City plans to build pavements on Bristol and Greenwood Aves., Linder St. and Weston Rd., involving 23,000 sq.yd. asphalt on 6 in. concrete base. About $93,950. R. C. Harris, City Hall, engr.

B. C., Vancouver—City Council soon lets contract paving Pacific St. from Granville to Broughton Sts., and various other streets, 16 ft. wide, asphaltic concrete. About $50,000. F. L. Fellowes, City Hall, engr.

BIDS DESIRED

New York—Until July 22, by State Highway Comn., Capitol, Albany, improving roads in following counties: Cattaraugus Co., 4.6 mi. Bradford-Carrolton, Part 1, Rd. No. 8007, concrete;

Chautauqua Co., 4.29 mi. Fredonia-Silver Creek, Part 2, Rd. No. 8003, concrete;

Chenango Co., 4.78 mi. Rockwell Mills-South New Berlin, Rd. No. 1497, bituminous macadam; 5.57 mi. Oxford, Part 1, Rd. No. 8001, concrete; 5.87 mi. Oxford, Part 2, Rd. No. 8002, concrete;

Lewis Co., 4.74 mi. Barnes Cors-Copenhagen, Part 2, Rd. No. 1442, bituminous macadam;

Onondaga Co., 27 mi. Solvay-State Fair-Syracuse, Rd. No. 1353 A, concrete;

Rensselaer Co., 1.44 mi. Riders Mills-Brainard, Rd. No. 1521, bituminous macadam;

Suffolk Co., 3.85 mi. Smithtown-Fort Salonga, Part 1, Rd. No. 1048-A, concrete.

Completing roads in following counties: Cayuga Co., 8 mi. Auburn-Weedsport, Rd. No. 1317; 6.06 mi. Fleming-Scipio, Part 2, Rd. No. 1327-A, bituminous macadam concrete; 5.45 mi. Venice Center-Genoa, Rd. No. 1414, concrete;

Chautauqua Co., 3.9 mi. Fredonia-South Dayton, Part 3, Rd. No. 1381, concrete;

Chenango Co., 7.12 mi. Afton-Coventry, Part 1, and Afton-Bettsburg, Rd., No. 1171, waterbound macadam; 7.9 mi. Norwich-South New Berlin, Part 2, and South New Berlin-New Berlin, Part 1, Rd. No. 1394, waterbound macadam; 3.06 mi. Otselic-Smyrna, Part 1, Rd. No. 1473, bituminous macadam;

Franklin Co., 10.36 mi. Malone-Chateaugay, Rd. No. 5613, bituminous macadam;

Niagara Co., 7.79 mi. Youngstown-Lockport, Part 1, Rd. No. 800, concrete;

Oswego Co., 6.36 mi. Sandy Creek-Smartville, Rd. No. 1428, bituminous macadam;

Saratoga Co., 6.1 mi. Rexford Flats-Wait Corners-Groom Corners, Rd. No. 1117, bituminous macadam; 5.74 mi. Mechanicsville-Clifton Park, Rd. No. 1345, bituminous macadam;

Seneca Co., 4.89 mi. Waterloo-Burns Corners, Rd. No. 1400, concrete; 2.13 mi. Willard-Ovid, Rd. No. 1401-A, concrete.

Repairing roads in following counties: Allegheny, Steuben and Schuyler Counties, Rds. No. 5502, 1420, 742, 850, 904, 1000-A, 1102, 1200, 5211, 5253, 5348, 5564, 5611, Repair No. 1231;

Oswego Co., Rds. No. 5251 and 5276, Repair Contr. No. 1215;

Suffolk Co., Rd. No. 743, Repair Contr. No. 1210; completing repair roads in following counties: Chenango Co., Otselic-South Otselic, Part 1, Rd. No. 664, Repair Contr. No. 1024;

Cortland Co., State Rd.-Homer, Rd. No. 380, State Rd.-Scott, Rd. No. 381, Repair Contr. No. 1037. F. S. Green, comr.

New York — Until July 29, by State Highway Comn., Albany, improving roads in Chautauqua and Jefferson Counties, also completing highways in Allegany, Cattaraugus, Cayuga, Dutchess, Franklin, Jefferson, Livington, Monroe, Oneida, Onondaga, Orange, Schuyler and Wayne Counties. F. S. Greene, comr.; advertised in this issue.

N. Y., Brooklyn—Until July 16, by E. Riegelmann, boro. pres., regulating, grading, curbing and laying sidewalks on East 39th St. from Ave I to new street north of Ave. I; 87th St. from 4th to 5th Aves.; regulating and paving with permanent asphalt pavement on 6 in. concrete foundation East 39th St. from Ave I to new street north of Ave I, President St. from Utica to Rochester Aves., Snediker Ave. from Riverdale Ave. to Newport St., West 11th St. from Ave. S to Ave. T, Woodbine St. from Irving to Knickerbocker Aves.; regulating and restoring pavements within railroad area removed and damaged in connection with construction of sewers in roadway of Ocean Ave., from Ave. O to Ave V; regulating and repaving with special granite pavement on present concrete foundation roadway of Washington Ave. from President St. to Empire Blvd.

N. Y., Long Island City—Until July 14, by M. E. Connolly, pres. Queens Boro., Queens Subway Bldg., 68 Hunterspoint Ave., regulating and paving with permanent asphalt on concrete foundation, curbing and laying sidewalks (where not already laid to grade and in good condition) in Edison Pl. from Myrtle Ave. to Cypress Hills Cemetery, 2nd Ward; regulating and grading sidewalks where necessary on west side 109th St. from 101th St. to Liberty Ave. and in intersections of 109th St. with 103rd Ave.; regulating, grading, curbing and paving with permanent asphalt on 6 in. concrete foundation, Lotus Ave. from Cypress Hills Rd. to Cooper Ave., from Harold to Gosman Aves., Silver St. from Anthon Ave. to Buchman Ave., 2nd Ward, Summerfield St. from Wyckoff to Myrtle Aves., 2nd Ward, Trowbridge St. from Willow St. to Van Alst Ave., 1st Ward.

N. Y., S. I., St. George—Until July 15, by C. D. Van Name, pres. Richmond Boro., repairing with bituminous concrete pavement roadways of Richmond Ave. and Old Stone Rd. from Blackford Ave. to Richmond Hill Rd. and Innis St. from Morningstar Rd. to John St.

N. J., Jersey City—Until July 25, by Blvd. Comn. Court House, repaving Hudson Co. Blvd. from Paterson Plank Rd. to Hackensack Plank Rd., bituminous pavement on concrete surface. About $75,000. Noted June 26.

Pennsylvania—Until July 29, by State Highway Dept., Harrisburg, building roads in Adams, Beaver, Bradford, Chester, Delaware, Crawford, Erie, Fayette, Jefferson, Lawrence, Mifflin, Montgomery, Bucks, Northampton, Susquehanna, Union, Washington and Westmoreland Counties. L. S. Sadler, state highway comr.; advertised in this issue.

Pa., Ebensburg—Until July 14, by Supervs. Allegheny Twp., c/o Controller of Cambria Co., improving 17,490 ft. Carrolltown Rd., 17 ft. wide, vitr. brick on concrete base, involving 35,000 lin.ft. cement curbing, etc. About $125,000. D. W. Dillman, 8081 Altoona Trust Bldg., Altoona, engr.

Pa., Ebensburg—Until July 16, by Spangler Boro. Council, c/o Cambria Co. Controller, rebuilding 1800 ft. road from Bigler Ave. to Barr Twp., Spangler Boro. About $20,000. L. J. Pfeister, boro. engr.

Pa., Pittsburgh—Until July 17, by Allegheny Co., paving between tracks 2540 ft. Glass and West Run Rds., in Homestead and Hays Boros., 14 ft. wide, with Ligonier Block edging and vitr. brick, concrete base. R. V. Warren, Court House, engr.

W. Va., Fayetteville—Until July 14, by Comrs. Fayette Co., grading 3 mi. road from Fayette to Lansing, involving 45,000 cu.yd. excav. J. K. McGrath, Fayetteville, engr.

W. Va., Huntington — Until July 15, by Cabell Co., building 1 mi. Hamlin-Huntington Rd., vitr. brick. J. H. Sanborn, Huntington, engr.

W. Va., Williamson — Until July 19, by Mingo Co., building 4 mi. earth road from Matewan to Thacker.

Fla., Sea Breeze—Until July 24, by city paving 42,000 sq.yd. Main St., involving 34,000 lin.ft. curbing 7000 cu.yd. excav., etc.

Miss., Columbus—Until July 12, by Highway Comrs. 4th Supervs. Dist., building 30 mi. road, all local gravel and long haul. G. E. Hauser, Columbus, engr.

Streets and Roads (Continued)

Ohio—Until July 18, by State Highway Comm., Columbus, building roads in following counties:

Ashland Co., Sect. "B" Ashland-Wooster Rd., 3.8 mi. grading, constructing bridges and culverts and paving with concrete, cost $123,454.

Butler Co., Sect. "B" Oxford-Millville Rd., 4.95 mi. grading, constructing bridges and culverts and paving with mastic or monolithic brick, bituminous concrete or sheet asphalt, $155,417.

Sect. "C-2" Oxford-Millville Rd., 3.60 mi. grading, constructing bridges and culverts and paving with mastic or monolithic brick, bituminous concrete or sheet asphalt, $142,635.

Sect. "A2" Hamilton-Middletown Rd., 1.36 mi., paving with bituminous macadam, $22,834.

Clinton Co., Sect. "B" Wilmington-Xenia Rd., 3.3 mi., resurfacing with waterbound macadam and repairing shoulders, $22,640.

Coshocton Co., Sect. "C-2" Newark Coshocton Rd., 2.04 mi. grading, constructing bridges and culverts and paving with monolithic brick or rein.-con., $77,784.

Franklin Co Sect. "M" Columbus-Sandusky Rd., 0.72 mi. grading, constructing drainage structures and paving with brick on concrete base, $41,157.

Sect. "O" Columbus-Sandusky Rd., 0.76 mi. grading, constructing drainage structures and paving with brick on concrete base, $43,245.

Geauga Co., Sect. "T, U, & V-1" Chagrin Falls-Greenville Rd., 8.17 mi. grading, constructing bridges and culverts and paving with concrete, $305,175.

Guernsey Co., Sect. "K" Cambridge-Coshocton Rd., 2 mi. grading and paving with brick, $8400.

Miami Co., Sect. "D" Dayton-Covington Rd., 3.59 mi. grading, constructing bridges and culverts and paving with rein.-con., $100,623.

Sect. "H" Piqua-Urbana Rd., 0.53 mi. grading and paving with rein.-con. $15,800.

Summit Co., Sect. "A, B, C, D & E" Akron-Cleveland Rd., 16.70 mi. grading, constructing bridges and culverts and paving with brick or rein.-con. $881,622.

O., Burbank—Until July 21, by Comrs. Wayne Co., Wooster, paving Wooster-Burbank Rd., bituminous macadam, cost $15,757. L. Smith, co. clk.; advertised in this issue.

O., Doylestown—Until July 16, by Comrs. Wayne Co., Wooster, paving Doylestown Hill, cost $2787; Portage St., $49,359, both bituminous macadam. L. Smith, co. clk.; advertised in this issue.

O., Lisbon—Until July 17, by Comrs. Columbiana Co., grading, draining and macadamizing with waterbound macadam, 10,578 ft. Lisbon-Salineville Pub. Rd., Washington Twp., involving 22,165 cu.yd. excav., 10,578 lin.ft. finishing bermes and ditches, 16,455 sq.yd. waterbound macadam and bridges and culverts. About $43,664. C. E. Hamilton, clk.

O., Yorkville—Until Aug. 4, by Village Council, paving Pub. Rd. St. from Ohio Valley Turnpike to terminus on west corporation line, hard burnt vitr. brick set on edge, hard burnt vitr. block or concrete. J. A. Hagan, clk.

Indiana—Until July 15, by State Highway Comn., Indianapolis, building highways in St. Joseph, Johnson and Marion, Putnam and Hendricks, Wayne, Marion, Marion and Hamilton, St. Joseph and Elkhart and Jackson Counties; advertised in this issue.

Ind., Shelbyville — Until July 23, by Comrs. Shelby Co., building 10,600 ft. gravel road between Shelby and Hancock Co., also improving 10,600 ft. Marshall-Millburn Rd. between Shelby and Hancock Counties. F. W. Fagel, co. aud.

Mich., Adrian—Until July 18, by G. P. Love, city clk., laying bituminous macadam pavement, 30 ft. wide, curbing and guttering where not at present laid, from north line Seeley St. to north line Albert St., also from North line Albert St. to city line on north; advertised in this issue.

Mich., Port Huron—Until July 17, by Comrs. St. Clair Co., County Bldg., grading, shaping, draining and building drainage culverts and surfacing 6¾ mi. road known as Lynn-Mussey Rd. in vicinity of Capac, Assessment Dist. Rd. No. 22; also 4½ mi. gravel road known as Harris Rd. in vicinity of Lake Shore, Assessment Dist. Rd. No. 20. D. Belyea, co. engr. Noted May 8.

Ill., Fair Haven—Until July 19, by J. F. Plumer, town clk., Chadwick, building 4.9 mi. Route "A," Project No. 1, gravel or macadam.

Wisconsin—Until July 16, by State Highway Comn., Div. No. 5, La Crosse, improving Fountain City-Winona Rd., Buffalo Co., Federal Aid Project No. 87, involving 38,099 cu.yd. earth, 2619 cu.yd. rock, 149 cu.yd. borrow and 731 cu.yd. earth (creek channel) excav., 257 cu.yd. Class "A" and 12 cu.yd. Class "B" concrete, 133 sq.yd. concrete surfacing, etc.

Wisconsin—Until July 17, by State Highway Comn., Div. No. 4, Grand Rapids, improving Portage-Stevens Pt. Rd., Marquette Co., Federal Aid Project No. 93, involving 17,745 cu.yd. earth and 151 cu.yd. borrow excav., 138 cu.yd. Class "A" concrete, 36,881 sq.yd. gravel surfacing, etc.

Wis., Clintonville—Until July 14, by L. P. Pelishek, engr., City Hall, grading and paving 3 mi. Main and Elm Sts., 18 ft. wide. Noted June 12.

Minn., Duluth—Until July 14, by J. A. Farrell, comr., laying 24 ft. concrete roadway and 6 ft. concrete walk on 1312 ft. 64th Ave. W., from Grand Ave. to Roosevelt St. About $22,408. Work involves 2562 lin.ft. concrete curbing, 7130 lin.ft concrete sidewalk, 4175 cu.yd. earth and 20 cu.yd. rock excav., 4175 sq.yd. concrete, 1312 ft. 12-24 in. pipe, etc.

Minn., Duluth—W. H. Borgen, aud. St. Louis Co., receiving bids improving 5 mi. road as follows: clearing and grubbing 1½ mi. Walsh road, ditching and grading 1¾ mi. Goodell Rd., clearing and grubbing 1 mi. Ralph Rd., clearing and grubbing portion of Brown Rd., clearing, grubbing, grading, ditching, corduroying and installing culverts on Graham Rd., grading, grubbing, ditching and installing culverts on Woodland Rd., clearing, grubbing, ditching, corduroying and installing culverts on Mason Rd. and side ditching 3048 cu.yd., 1578 cu. yd. offtake ditch and 46 cu.yd. culverts trenches on Victor Rd. Separate bids will be received on clearing and grubbing. R. W. Acton, 115 8th Ave., E., engr.

Minn., Litchfield—Until July 16, by F. O. Holm, village recdr., grading, paving and curbing various streets, Sect. 1, involving 5275 cu.yd. grading, 23,531 sq.yd. paving and 7746 lin.ft. curbing; Sect. 2, 4668 cu. yd. grading, 15,343 sq.yd. paving and 3517 lin.ft. curbing. L. P. Wolff, Guardian Life Bldg., St. Paul, engr.

Minn., St. Paul—Until July 14, by H. W. Austin, purch. agt., City Hall, paving Como Ave., between Rice St. and Great Northern R.R. bridge, involving 15,141 sq. yd. 3½ in. southern pine creosoted wood blocks, 2900 bbls. Portland cement, 1347 cu.yd. concrete sand, 2247 cu.yd. crushed stone or gravel, 1809 cu.yd. cushion sand, 105,987 lbs. pitch filler, 1000 lbs. asphalt filler, 2997 ft. B. M. No. 1 rough pine lumber, 3 x 12 in., 625 lin.ft. 12 in. V. C. sewer pipe, 9200 sewer bricks, 139 lin.ft 20 ft., 212.7 lin.ft. 15 ft., 126 lin.ft. 2 ft. sandstone curb, etc.

Kan., Junction City—Until July 28, by city, for 50,000 sq.yd. 3 in. vertical fibre brick No. 1 brick block, concrete or asphaltic concrete pavement, 10,000 cu.yd. excav. and 20,000 lin.ft. curb and gutter. J. N. Bridgman, city paving engr.

Neb., Lincoln—Until July 21, by T. H. Berg, city clk., paving 19th, Park, 24th, 16th and Dudley Sts., 25 ft. wide, involving 434 sq.yd. vertical fibre brick, 17,964 sq.yd. asphaltic concrete, 1335 sq.yd. concrete, 696 lin.ft. concrete curbing, 13,676 lin.ft. curbing and guttering, and 2339 cu.yd. earth excav. About $65,100. No bids received on former advertisement. G. W. Bates, city engr. Noted June 26.

Mo., Albany—Until July 15, by city, for 25,000 sq.yd. vertical fibre brick pavement, 10,000 cu.yd. grading, 14,000 lin.ft. combined curb and gutter, 1500 lin.ft. storm sewer, 16 catch basins and 7 manholes. Archer & Stevens, 609 New England Bldg., Kansas City, engrs.

Mo., Bethany—Until July 23, by Harrison Co. Court, grading, paving with concrete 9 ft. wide, laying macadam shoulders, etc., on 9.4 mi. State Rd., Project No. 8. M. G. Hall, Centerville, Ia., engr.; advertised in this issue.

Mo., St. Joseph—Until July 26, by Buchanan Co. Court, grading and paving 2.2 mi. state road from St. Joseph to One Hundred and Two River, 2½ in. asphaltic concrete, 18 ft. wide. J. D. Mohler, St. Joseph, special highway engr. Noted June 26.

Arkansas—Until July 21, by Comrs. Old Town Rd. Impvt. Dist. of Phillips Co., at office of State Highway Comn., Little Rock, building 15 mi. concrete highway. J. M Quarles, Helena, engr.; advertised in this issue.

Tex., Baird—Until July 14, J. R. Black, Judge Callahan Co., surfacing with crushed rock and gravel 34.85 mi. Highway No. 1 from Eastland Co. line to Taylor Co. line, 16 ft. wide. About $6000 per mi. H. H. Fielder, Cisco, engr. Noted June 26.

Colo., Denver—Until Aug. 24, by city, paving Alley Paving Dist. No. 50 and 51, concrete. About $25,589 and $22,505 respectively. J. B. Hunter, city engr.

New Mexico—Until July 15, by State Highway Comn., Santa Fe, building Sects. 3, 4 and 5 State Rd. No. 6, Federal Aid Project No. 4, Valencia Co. L. A. Gillett, state highway engr.

Utah—Until July 15, by State Highway Comn., Salt Lake City, paving 3.2 mi. state road from Roy to Ogden, 18 ft. wide, 2 in. bituminous concrete over existing tarvia base; also 3 mi. from North Ogden to Utah Hot Springs, 18 ft. wide, I. R. Browning, c/o State Highway Dept., Salt Lake City, engr.

Wash., Anacortes—Until July 15, by City Council, paving 8396 ft. 7th, 8th, 9th and K Aves., 16 ft. wide, bitulithic concrete. About $37,329. W. B. Short, city engr.

Quebec—Until July 18, by Dept. Rds., Quebec, graveling 75 mi. Provincial Roads. 30, 35 and 40 ft. wide, between Yamaska and Sorel. About $100,000. M. Henry, c/o Dept. Rds., engr.

Quebec—Until July 23, by Dept. Rds., Quebec, building 9 mi. waterbound macadam roads in town of St. Antoine. About $36,000. M. Henry, c/o Dept. Rds., engr.

Que., St. Johns—Town receiving bids building 6 mi. concrete roads and sidewalks. About $34,090. W. H. Bourassa, Town Hall, engr.

Ont., Caledonia—Until July 18, by town, building 22,700 sq.yd. 3 in. tar penetration roads, on 6 in. stone base. Work involves 1400 lin.ft. 6 in. curbing and 1500 cu.yd. earth excav., tar penetration roads. J. W. Avery, clk.

Ont., Owen Sound—Until July 18, by D. H. Fleming, engr., Owen Sound, resurfacing 30,000 sq.yd. macadam with asphaltic concrete, about half requiring concrete base, also constructing 3 mi. curbs and gutters. Noted June 19.

Ont., Kingston—Until July 12, by city, for 8000 ft. pavement, 24 ft. wide, asphalt, asphaltic concrete, asphalt or bituminous macadam or tarvia macadam, 10,500 ft. combined curb and gutter, 6200 ft. concrete gutter and 25,000 sq.yd. 5 in. concrete base. R. J. McLelland, city engr.

Ont., Welland—Until July 21, by Welland Co., building 10 mi. waterbound or bituminous penetration macadam and ½ mi. concrete roads, 22 ft. wide. About $150,000. G. Ross, Welland, engr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★R. I., Cranston—City let contract resurfacing 22,858 sq.yd. Cranston St., sheet asphalt, to E. P. Tracy, 200 Olivia St., Derby, Conn., $1.52 per sq.yd., total cost $34,744. Noted April 17.

New York—State Highway Comn., Capitol, Albany, received bids July 1, improving roads in following counties: (a) Albany Co., 3.98 mi. Schenectady Co. Line-Guilderland Rd., No. 5636;

(b1) Herkimer Co., 5.84 mi. Vanhornesville-Starkville Rd. No. 1362, (b2) 5.67 mi. Paines Hollow-Stone House, Rd. No. 1363;

(c) Oneida Co., .45 mi. North Western-Boonville, Pt. 3, Rd. No. 1462;

(d) Putnam Co., 3.33 mi. Westchester Co. Line-Mahopac Falls, Rd. No. 1512;

(e1) Saratoga Co., 9.06 mi. Schuylerville-Gansevoort, Rd. No. 1461, (e2) 1.52 mi. Wait Cors-Lape Cors, Rd. No. 1523;

(f1) Suffolk Co., 6.59 mi. Bridgehampton-Devon, Pt. 1, Rd. No. 1495, (f2) 4.99 mi. Bridgehampton-Devon, Pt. 2, Rd. No. 1524; completing roads in following counties:

(g) Cayuga Co., 6.98 mi. Port Byron-Weedsport, Rd. No. 5609;

(h) Cortland Co., 6.07 mi. Solon-Gee Brook, Pt. 1, Rd. No. 1435;

Streets and Roads (Continued)

(i) Erie Co., 6.03 mi. Wales Center-Wales, Rd. No. 924-B;
(j) Franklin Co., 1.99 mi. Main and Elm Sts., Malone Village, Rd. No. 5602;
(k) Hamilton Co., 5.01 mi. Tupper Lake-Long Lake, Pt. 1, Rd. No. 1258;
(l) Jefferson Co., 4.05 mi. Carthage-Antwerp, Pt. 4, Rd. No. 5618;
(m) Niagara Co., 8 mi. Cambria-Wilson, Rd. No. 1315;
(n) Schenectady Co., 5.62 mi. Schenectady-Duanesburg, Pt. 2, Rd. No. 5545;
(o) Wayne Co., 5.85 mi. Sodus-Alton, Rd. No. 5632; also repairing roads in following counties:
(p) Rensselaer Co., Rd. No. 490. Repair No. 1208;
(q) Ulster Co., Rd. No. 16, Repair No. 1224, from
Veeder Contg. Co., Inc., Delevan, (a) $108,213,
Brown, Lowe & Parker, Schenectady, (a) $113,751,
Latus & Hawkins, Albany, (a) $116,279,
F. V. Brotsch Co., 1 and B Bldg., Rochester, (b1) $213,423, (b2) $193,112, (c) $28,964;
Rosoff Eng. Co., 15 Park Row, New York City, (b1) $215,503; (k) $91,669,
D. J. Phelan & Co., Utica, (c) $28,283,
McCarthy & Rock, Winthrop, (c) $30,008,
S. Beskin, Beacon, (d) $83,175,
F. G. Fowler Constr. Co., Mt. Kisco, (d) $86,210,
Hughes & Gardner, North Tarrytown, (d) $93,854,
McArthur Bros., 120 Bway., New York City, (e1) $339,793, (f1) $306,435, (f2) $270,063,
Harradine Bros. Co., Inc., Spencerport, (e2) $38,683, (o) $9305,
Pearl Investing Co., Inc., Albany, (e2) $38,782,
H. A. Schaupp, Inc., Guilderland, (e2) $39,628, (n) $73,594,
Good Rds. Eng. & Contg. Co., Inc., Portchester, (f1) $242,205, (f2) $214,111,
C. D. Schlemmer, Islip, (f1) $251,345, (f2) $221,362,
Underpinning & Foundation Co., 290 Bway., New York City, (f1) $258,580, (f2) $231,694,
J. J. McDermott, Port Washington, (f1) $259,018, (f2) $226,522,
Kennedy Constr. Co., Albany, (g) $29,256,
Hendrickson-McCabe Constr. Co., Rochester, (g) $29,817, (o) $8518,
I. M. Ludington Sons, Inc., Powers Bldg., Rochester, (g) $32,231,
D. W. Robbins, Inc., Utica, (h) $111,470,
T. Grady, Rochester, (h) $114,821,
Felton Constr. Co., Buffalo, (i) $81,567,
A. F. McConville, Ogdensburg, (j) $25,974,
J. M. Allen, Newark, N. J., (k) $93,578,
A. J. Rockwood, Rochester, (k) $97,961,
Dale Eng. Co., Mann Bldg., Utica, (l) $66,385,
L. J. Devlin, Rensselaer, (m) $62,560,
P. J. Mumm Contg. Co., Inc., Buffalo, (m) $129,755,
O. M. Singer, Wilson, (m) $135,407,
J. J. Malloy, Schenectady, (n) $66,450,
Cleveland & Sons, Brockport, (o) $13,934,
Troy Contg. Co., Troy, (p) $85,689,
J. Fitzgerald, Hoosick Falls, (p) $87,090,
J. F. Gallagher, Kingston, (q) $54,295,
F. W. Hamilton, Rochester, (q) $57,857.
Noted June 12.

N. Y., Long Island City—M. E. Connolly, pres. Queens Boro., received bids June 26, regulating, grading, curbing and laying sidewalks on (a) 93rd Ave., (b) Olmstead Pl., (c) 16th Ave., (d) Hancock St., from R. A. Hess, Inc., (a) $2247; Scott & Kurth, (a) $2301, (b) $3309; Grimm Constr. Co., (a) $2344, (b) $3182; C. Gallagher, (a) $2354, (b) $3037; Sicilian Asphalt Paving Co., 41 Park Row, New York City, (c) $5783, (d) $4955; Uvalde Asphalt Paving Co., 1 Bway., New York City, (c) $5935, (d) $5249; Borough Asphalt Paving Co., 1301 Metropolitan Ave., Brooklyn, (c) $6180, (d) $5411. Noted June 19.

N. Y., Utica—Bd. Contr. & Supply received only bid building parkway extension, beginning at Welsh Bush Rd. and extending along Thomas Proctor Park, to Rutgers St., from H. W. Roberts, 610 Lansing St., bitulithic, $37,240, sheet asphalt, $33,934, asphaltic concrete, $36,196.

New Jersey—State Highway Comn., Broad St. Bank Bldg., Trenton, received bids building State Highway Route No. 1, Sect. 3, Robbinsville to Windsor, Mercer Co., from Hugh Nawn Contg. Co., 1211 Chestnut St., Phila., $149,562; H. Wilhelm Sons, Inc., Elizabeth, $157,548; Harop & Shannon, Inc., Garfield, $159,991. Noted June 19.

★**N. J., South Orange**—Village let contract paving sidewalks andcurbing 15,000 ft. Irving Ave., to J. Sellitto, 163 Church St., $24,246. Work involves 2850 lin.ft. curbing, 11,500 lin.ft. sidewalk, 1400 cu.yd. excav.

★**Pennsylvania**—State Highway Dept., Harrisburg, let contracts to H. Nawn Contg. Co., Phila., for 19,706 ft. rein.-con. pavement on Route No. 140 and 24,765 ft. on Route No. 199. Dauphen Co., cost $143,812 and $186,863 respectively; to Mason & Hanger, Inc., Chambersburg, for 25,402 ft. rein.-con. and Hillside vitr. brick, on Route No. 161, Northumberland Co., $199,629; to Boyle Constr. Co., Wilkes-Barre, for 9148 ft. bituminous surface course on concrete foundation, Routes Nos. 239 and 249, Columbia Co., $84,630; to W. P. McDonald Const. Co., Phila., for 10,802 ft. bituminous surface course on concrete foundation, Routes Nos. 3 and 4, Columbia Co., $157,433; to Standard Contg. Co., Altoona Trust Bldg., Altoona, 1269 ft. rein.-con., Route 260, Blair Co., $19,880; to Claiborne-Johnston Co., 10th Ave. and 6th St., Baltimore, Md., for 21,506 ft. rein.-con., Route No. 136, Lancaster Co., $162,093. Noted July 3.

★**Pennsylvania** — State Highway Dept., Harrisburg, let contract building roads in counties as follows:
Blair Co., 890 ft. rein.-con., Gaysport Boro., to Standard Contg. Co., Altoona Trust Bldg., Altoona, $5872; 23,075 ft. repair work, Logan Twp., to Eastern Paving Co., Colonial Trust Bldg., Phila., $27,200.
Bradford Co., 6640 ft. concrete, Athens Twp., to Valley Constr. Co., Athens, $38,540.
Cambria Co., 32,180 ft. rein.-con. and Hillside vitr. brick, Jackson Twp., to Nicola Bldg. Co., Penn and Denniston Aves., Pittsburgh, $259,956.
Centre Co., 27,940 ft. bituminous surface ocurse or rein.-con. Boggs Twp., to Vipond Constr. Co., 2222 Beale Ave., Altoona, $215,711.
Chester Co., 2932 ft., bituminous surface course or rein.-con., Oxford Boro., to Juniata Co., Empire Bldg., Phila., $21,602.
Cumberland Co., 24,275 ft. rein.-con. and Hillside vitr. brick, Upper Allen Twp., to Langthorne Co., New York City, $181,605.
Crawford Co., 9067 ft. rein.-con., Woodcock and Hayfield Twps., to Keystone Constr. Co., Meadville, $62,627.
Erie Co., 4854 ft. bituminous surface course on concrete foundation and Hillside vitr. brick, Girard Boro. and Twp., to Mayer Bros. Constr. Co., Commerce Bldg., Erie, $86,634; 20,200 ft. rein.-con., Wayne Twp., Highway Constr. Co., Erie, $136,532; 27,409 ft. bituminous surface course and Hillside vitr. brick on concrete foundation, Mill Creek and Fairview Twps., to Campbell Bros. Co., Stambaugh Bldg., Youngstown, O., $237,684.
Lancaster Co., 37,684 ft. bituminous surface or rein.-con., East and West Hempfield Twps., to Freeland Constr. Co., Freeland, $247,273.
Lycoming Co., 39,319 ft. rein.-con., Platt and Woodward Twps., to W. J. Gephart, Pittsburgh, $322,931.
Mercer Co., 3678 ft. bituminous surface course or rein.-con., on concrete foundation, Grove City Boro., to Brackenridge Sand & Gravel Co., Brackenridge, $44,169.
Potter Co., 26,400 ft., bituminous surface course or rein.-con. on concrete foundation, Eulalia and Roulette Twps., to Horn & Devling, Main St., Galeton, $215,048.
Warren Co., 6544 ft. rein.-con., Youngsville Boro., to J. McCormick & Bros., Erie, $39,907.
York Co., 40,712 ft. bituminous surface course on concrete foundation and Hillside vitr. brick, or rein.-con. and Hillside vitr. brick, Carroll and Franklin Twps., to Langthorne Co., New York City, $297,908. Noted June 26.

★**Pa., Clairton**—Boro. let contract grading, paving, curbing and sewering section of Miller Ave., to C. Donatella, 1313 Collier St., Pittsburgh. About $54,000. Noted June 19.

★**Pa., Crafton** (Pittsburgh P. O.)—Boro. let contract grading, paving and curbing Barr St. from Keever to Williard Sts. and Harris Ave. from Barr to Clearview Sts., to J. Creary. About $8000 and $20,000 respectively. Noted May 22.

★**Pa., Dormont** (Pittsburgh P. O.)—Boro. let contract grading, paving and curbing Pinehurst and Latonia Aves., to J. P. Gary, Kensington House, New Kensington. About $17,782. Noted July 3.

★**Pa., Greensburg**—Westmoreland Co. let contracts building 3.10 mi. Greensburg-Scottdale Rd., to Corrado & Galiardi, cost $140,436 brick, $125,931 concrete; 2.88 mi. road in Ligonier Twp., to J. Hermann, $96,010 brick, $75,734 concrete. Noted June 5.

★**Pa., Pittsburgh**—Allegheny Co. let contract building 5700 ft. Painters Run Rd. in Bridgeville Boro., to T. Cronin. South 17th and Muriel Sts., $53,137. Work involves 625 sq.yd. vitr. brick, 7915 sq.yd. concrete, 1000 sq.yd. paved gutter, 12,000 cu.yd. earth excav. and 3100 ft. 6 in. vitr pipe drain. Noted Apr. 24.

★**Pa., Pittsburgh**—Allegheny Co. let contract grading, paving and curbing 2050 ft. Main St., in Baldwin Twp., from Library Rd. to Carrick Boro. line, 24 ft. roadway, to M. Ott & Co., 414 Warrington Ave., $34,135. Noted June 5.

★**Pa., Pittsburgh**—Allegheny Co. let contracts improving 5280 ft. McCoy Rd., 18 ft. wide, to J. H. McQuaide & Sons Co., Bakewell Bldg., $46,040; 3 mi. Bull Creek Rd., 16 ft. wide, concrete base and asphaltic concrete surface, to Booth & Flynn, 1942 Forbes St., $104,264. Noted June 26.

★**Pa., Reading**—City let contract for 10,000 sq.yd sheet asphalt pavement, to Dewey Cement Gun Constr. Co., 836 Hamilton St., Allentown. Noted June 12.

★**Pa., Washington**—Washington Co. let contracts improving 5400 ft. Beallsville-Zollarsville Rd., 14 ft. wide, concrete, to Donora Constr. Co., 1st and 2nd Sts., Donora, $32,424; 1400 ft. West Alexander-Mechanic St. Rd., 24 ft. wide, rein.-con., to Tarentum Sand & Gravel Co., Tarentum, $12,223; 6600 ft. Avella-Cross Creek Rd., 14 ft. wide, concrete, to G. S. White & Co., Jenkins Arcade, Pittsburgh, $39,883; 9500 ft. Midway-Primrose Rd., 16 ft. wide, rein.-con., to McPherson Bros., 421 Chestnut St., Sewickley, $58,073; 8800 ft. Burgettstown-Bulger Rd., 16 ft. wide, rein.-con., to Federal Constr. Co., Pittsburgh, $56,135. Noted June 5.

★**Pa., Williamsport** — City let contract paving sections of Cemetery, Race, Maynard, William and Locust Sts. and Park Ave., to Busch & Stewart, Trust Bldg. About $10,000.

★**Md., Baltimore**—Bd. of Awards let contracts to Arundel Constr. Co., 911 Eastern Ave., grading, curbing and paving Crooked Lane, involving 340 sq.yd. granite block relaid with 5 in. concrete base, and Washington Pl., 1540 sq.yd. Hillside vitr. brick block with cement filler on 5 in. concrete base, Contr. No. 164, cost $7547, also Brevard St. and 2 alleys running therefrom, 3910 sq.yd. 6 in. cement concrete, Contr. No. 165, $7058; P. Reddington & Sons, 2 East Lexington St., Arch, Vine and Pierce Sts. and Penn Alley, involving 11,920 sq.yd. 6 in. cement concrete, Contr. No. 166, $33,365. Noted June 12.

Virginia—State Highway Comn., Richmond, received bids building 2.69 mi. road from Ryans Mill to Coleen, waterbound macadam, Project No. 33, Nelson Co., from Royers & Shumway, Buchannon, $59,438, and J. L. Chandler, Virgilina, $39,797; 4.27 mi. road from Fairfield to Timber Church, waterbound macadam, Project No. 35, Rockbridge Co., from W. Z. Johnson, Lexington, $64,500, and L. R. Colbert, Fredericksburg, $68,000. Noted June 12.

★**W. Va., Wheeling** — Comrs. Ohio Co. let contract building 1 mi. National Rd. to Valley Grove, to Cass & Otto, Wheeling. About $35,056.

★**S. C., Spartanburg**—Comrs. Spartanburg Co. let contract relocating, grading, draining, building drainage structures and surfacing with top soil, 6.7 mi. road from Reidville to Duncan, Federal Aid Project No. 1213, 30 ft. wide, involving 35 cu.yd. concrete, 31,720 cu.yd. earth and 500 cu.yd. rock excav., 570 lin. ft. vitr. pipe and 23,628 cu.yd. top soil, to Cooley & Gillespie, Greenville, $31,510.

★**Ga., Washington** — City let contract paving, draining and curbing 118,000 sq.yd. main streets, to Ely Constr. Co., Lamar Bldg., Augusta. About $83,000. Noted June 26.

★**Fla., West Palm Beach**—Comrs. Palm Beach Co. let contract grading and hard surfacing 16.5 mi. road from here to Lake Okeechobee, to Bryan & Snyder Co., Ft. Lauderdale, $129,975.

Streets and Roads (Continued)

O., Cleveland—City received bids paving (a) East 125th St. from Luke to Abell Aves. involving 18,200 sq.ft. 4 in. brick paving on 6 in. concrete base and 1520 ft. 5 in. stone curbing, (b) East 63rd St. from Francis to Watterman Aves., 28,000 sq.ft. 4 in. brick on 6 in. concrete base and 2000 ft. 5 in. stone curbing, (c) East 55th St. from Howard to Brew Aves., 19,000 sq.ft. 5 in. brick paving on 6 in. concrete base and 1360 ft. 5 in. stone curbing, (d) East 4th St. from Huron to Bolivar Rds., 31,020 sq.ft. Medina block paving on 6 in. concrete base and 1000 ft. 5 in. stone curbing, (e) East 4th St. from Huron Rd. to Prospect Ave., 13,000 sq.ft. 5 in. granite block on 6 in. concrete base and 770 ft. 6 in. curbing, from A. M. Pejsa, 2359 East 93rd St., (a) $11,581, (b) $17,825. Baldwin Bros., 4500 Euclid Ave., (a) $11,659, (b) $17,457, (c) $13,251, (d) $25,952, (e) $12,892; Rieley Bros., 357 The Arcade, (a) $11,867, (b) $17,282, (c) $13,187, (d) $25,298, (e) $12,780; Cleveland Trinidad Paving Co., The Arcade, (c) $10,223; R. P. Burnett, Society for Savings Bldg., (d) $25,004, (e) $12,582.

★**O., Dayton**—City let contract paving 2000 ft. 3rd St. from Perry to St. Clair Sts., 60 ft. wide, involving 13,400 sq.yd. oil A wood block, 4200 lin.ft. granite curbing, and 2000 sq.ft. cement sidewalks, to E. D. Murray, 10 Cambridge Ave., $93,304. Noted June 26.

★**O., Toledo**—City let contract grading, draining, curbing and paving with rein.-con. 1248 ft. Martha St., 24 ft. wide, involving 1149 cu.yd. earth excav., to Peters Bros., 237 Marion St., cost $16,132; 2581 ft. Oakdale Ave., 26 ft. wide, rein.-con., involving 5012 cu.yd. earth excav., to Russel & Jennison, 2463 Bway., $32,718. Noted June 26.

★**Mich., Ford** (Wyandotte P. O.)—Village let contract paving and curbing 3000 ft. Goddard Rd. from Biddle Ave. to west village limits, 30 ft. wide, and 1400 ft. Hudson St. from Middle Ave to Detroit, Toledo, & Ironton R.R., 24 ft. wide, to Rice Constr. Co., Wyandotte. Noted June 26.

★**Illinois**—Dept. Pub. Wks. & Bldgs., Div. of Highways, Springfield, let contracts improving Sects. G, H, C, P-15d, and D, to J. Black Masonry & Constr. Co., 212 West Washington St., Chicago, $680,000; Sect. A1 and A2, to Holm Page Co., 1604 4th Ave., Rockford, $118,300; Sects. E, F and L-15d, to W. F. Smith & Co., Renssalaer, Ind., $307,986. Noted June 19.

★**Wis., Jefferson**—Bd. Pub. Wks. let contract grading and paving 9000 sq.yd. C St., from Rock River to 1st Ave., etc., to McNamara Constr. Co., Dubuque, Ia., $18,180. Noted June 5.

★**Minn., Blue Earth**—J. J. Herring, aud. Fairbault Co., let contract grading and graveling 20 mi. Federal Aid Project No. 36, 24 ft. wide, to H. Enke, Tyler, $115,000. Noted June 12.

★**Minn., Litchfield**—Comrs. Meeker Co. let contract improving 167.1 mi. State Rd. No. 6, Federal Aid Project No. 40, to S. J. Groves & Sons, 100 Kasota Bldg., Minneapolis, $107,689. Noted June 12.

★**Minn., Marshall**—R. D. Houdersheldt, aud. Lyon Co., let contract grading and graveling 9 mi. Federal Aid Project, State Rd. No. 6, to Spencer & Chambers, Marshall, cost plus percentage basis. Noted June 12.

★**Minn., Morris**—Comrs. Stevens Co. let contract paving 10 mi. State Rd. No. 2, Federal Aid Project No. 67, to Foley Bros., 209 Gilfillan Bldg., St. Paul, $280,167. Noted May 22.

★**Kan. Mankato**—City let contract paving, curbing and guttering various streets, vitr. brick on concrete base, to Central Bridge Co., Mankato, $35,392.

★**Neb., Ainsworth**—Village let contract to Bauer & Johnson, 201 Farnam Bldg., Omaha, paving 19,340 sq.yd. with rein.con. at $2.90 per yd., 6520 lin.ft curb and gutter, $1.10 per ft. and 4800 ft. of soft steel protection plates. Total cost, $62,968. Noted June 12.

★**Neb., Omaha**—Douglas Co. let contract paving 6 blocks Gilmore Ave. from Railroad Ave. to Harrison St., 30 ft. wide, involving 10,466 sq.yd. vitr. brick on 6 in. concrete base, 5540 lin.ft. curbing and 2700 cu.yd. earth excav., to Natl. Constr. Co., 4811 South 24th St., $36,939.

★**Neb., Stromsberg**—Comrs. Polk Co. let contract to Hugh Murphy Constr. Co., 204 Karbach Blk., Omaha, paving 19,926 sq.yd., with 3 in. brick blocks on 4 in. concrete base at $3.78 per yd., also 6900 ft. 24 in. combination and 1700 ft. 7 x 20 in. straight curbing and guttering, $1.12½ per ft. Total cost about $86,000.

★**Montana** — State Highway Comn., Helena, let contract gravel surfacing 2.02 mi. Hardin-Custer Rd., 18 ft. wide, Big Horn Co., to A. Carlson, Columbus, $16,811. Noted May 1.

★**Montana** — State Highway Comn., Helena, let contract gravel surfacing 4 mi. Tongue River Rd., Sec. No. 1, Custer Co., to Schlueter Bros., Miles City, $20,014. Noted June 12.

★**Mont., Laurel**—City let contract paving 2¼ mi. streets, to F. G. Steinmetz, Laurel, $20,668.

Tex., Bonham—Comrs. Fannin Co. received lowest 3 bids improving 7.121 mi. Bonham-Sherman Rd. from Ector to Grayson Co. line, 14 ft.-16 ft. wide, from J. W. Rooks, McAlester, Okla., $59,237; Allhands & Davis, Wills Point, $75,368; Womack Constr. Co., Dallas, $79,755. Noted June 12.

★**Tex., Houston**—Comrs. Harris Co. let contract building 9.213 mi. Highway No. 3 A, known at Katy Rd., to Snyder Bros., Bay City, $16,525. Noted May 8.

Tex., Jasper—Comrs. Jasper Co. received lowest 3 bids grading and gravel surfacing 16.21 mi. Highway No. 7 from Jasper, west to county line, 12 ft. wide, from Smith Bros. & Bland, Jasper, $122,046; Allhand & Davis, Wills Point, $127,467, J. S. Moore, Lufkin, $131,077. Noted June 12.

★**New Mexico**—State Highway Comn., Santa Fe, let contract building 12 mi. Federal Aid Project No. 15, from Las Cruces to Mesquite, Dona Ana Co., to Lee Moor Constr. Co., 312 Two Republics Bldg., El Paso, Tex. About $300,000.

★**Ariz., Bisbee**—City let contract for 40,000 sq.yd. concrete paving, 8 in. thick with wearing surface, cement curbs and walks, to F. V. McPeak, 2415 Gramercy Park, Los Angeles, Cal. About $105,000.

★**Washington**—State Highway Comn., Olympia, let contract paving 8 mi. Pacific Highway from Mt. Vernon to Snohomish Co. line, concrete, to McAdam & Co., Seattle, cost $244,664; 3 mi. Olympic Highway from Montesano west, concrete, to Aberdeen Paving Co., Aberdeen, $80,333; 3.2 mi. road from end of Montesano paving to east of golf links, 18 ft. wide, involving 41,200 sq.yd. 1 course concrete, to Blake Contg. Co., Montesano, $80,000. Noted June 12.

★**Washington**—State Highway Bd., Olympia, let contract paving 7 mi. Pacific Highway from Forest to Toledo, Post Rd. No. 27, concrete, Lewis Co., to T. M. Morgan, Auburn, cost $221,644; 4.5 mi. Sunset Highway from Deep Creek west to county line, Project No. 22, concrete, to Standard Asphalt Paving Co., 517 Lincoln St., Spokane, $131,358. Noted June 12.

★**Washington**—State Highway Bd., Olympia, let contract paving 3.9 mi. Sunset Highway east of Spokane Co., Spokane Co., to Clifton, Applegate & Toole, Hutton Bld., Spokane, $116,895; 2640 ft. Pacific Highway east of Everett, Snohomish Co., to J. V. Hoover Co., Everett, $32,204; 5.5 mi. Pacific Highway from Woodland to Martins Bluff, Cowlitz Co., to D. A. Williams, Bradley Rd. and Prospect Hill, Tacoma, $34,038; clearing, grading, draining and surfacing 7 mi. Pacific Highway from Olympia to Ternon, Thurston Co., to Alberton, Cornell & Simpson, Tacoma, $189,200; 7.8 mi. Chelan-Okanogan Highway from Tonasket to Oroville, Okanogan Co., to Anderson & McDowell, Molson, $51,325; 7.8 mi. Chelan-Okanogan Highway from Brewster to Malott, Okanogan Co., to R. A. Sloane, Seattle, $56,654; 4.9 mi. Sunset Highway east of Hartline, Grant Co., to A. A. Proulx, Almira, $44,268. Noted June 19.

★**Wash., Aberdeen**—City Council let contract building 45 blocks concrete sidewalk on Bway., G, H, I, K, L, 1st, 2nd, 3rd, 4th, 5th and 8th Sts., 6 ft. wide, involving 18,000 sq.yd. 4 in. concrete, to Haukell, Hegg Co., Aberdeen, $19,953. Noted June 5.

★**Wash., Aberdeen**—City Council let contract clearing, subgrading, paving, building sidewalks and drainage headers on Wishkah St. from Washington to Division Sts., 30 ft. wide, involving 4256 sq.yd. concrete, 2070 lin.ft. concrete curbing and 1410 sq.yd. 6 in. concrete sidewalks, to Grays Harbor Constr. Co., Aberdeen, $18,362. Noted June 12.

Wash., Bremerton—City received only bid paving Washington St., concrete, from Badiloto & Hulett, Seattle, $49,495.

★**Wash., Seattle**—Bd. Pub. Wks. let contracts to John & Bressi, Seattle, paving 32nd Ave. N. E., et al, involving 13,350 sq.yd. 6 and 7 in. concrete, 6680 lin.ft. concrete curbing and 3300 cu.yd. earth excav., cost $66,816, King St., et al, 30,300 sq.yd. concrete, 11,000 lin.ft. concrete curbing and 16,600 cu.yd. earth excav., $182,943; to F. McLellan, Seattle, paving East 50th St., et al, 26,940 sq.yd. concrete, 18,500 lin.ft. concrete curbing and 9200 cu.yd. earth excav., $101,079; to F. McHugh, Seattle, paving Rainier Ave., et al, 17,250 sq.yd. concrete on 6 in. concrete base, 7410 lin.ft. concrete curbing and 13,600 cu.yd. earth excav., $139,480. Noted June 12.

★**Wash., Vancouver**—Comrs. Clarke Co., let contract paving 4.75 mi. Feleda-Hazel Dell Rd., gravel bitulithic, to Warren Constr. Co., Journal Bldg., Portland, Ore., $110,283. Noted May 29.

★**Ore., Beaverton** — City let contract paving with bitulithic concrete, grading, draining and building concrete curbing on 12 blocks, to Warren Constr. Co., Journal Bldg., Portland, $15,514. Noted June 19.

Ore., Portland—City Council received bids grading and building sidewalks on East Flanders, East Davis, East Everett, East Burnside, East 69th, 70th and 71st Sts., from Alaska Plumbing and Heating Co., 413 East Morrison St., $12,552; M. Hansen & Co., $14,107; S. Simonsen, 841 East 10th St., $14,190; paving and building sidewalks on Cable St. from Terrace Rd. to Mill St., concrete No. 1, from Cochran Bros., $7600; East 62nd St. from Sandy Blvd. to Fremont St., from Warren Constr. Co., Journal Bldg., asphaltic concrete on crushed rock base, $9189; Cochran Bros., concrete No. 1, $9784; Minnesota Ave. from Emerson St. to Killingsworth Ave., from Cochran Bros., concrete No. 1, $3259.

★**Cal., Oakland**—City let contract paving 54th Ave., to Hutchinson Co., 444 17th St., $12,565. W rk involves 2031 lin.ft. redwood curbing, 5931 lin.ft. concrete gutter, 9085 lin.ft. cement sidewalk and 19,788 sq.ft. oil macadam pavement.

★**Que., Ste. Anne de Bellevue**—Dept. Pub. Wks., Ottawa, let contract for grading and other road work at Military Hospital, here, to I. Kert & Son, Montreal. About $22,882.

★**Ont., Ingersoll**—Town let contract to Frid Constr. Co., Sun Life Bldg., Hamilton, for concrete pavements at $2.15 per sq.yd., concrete curbing, $0.30 per lin.ft., 8 in. sewer, $1 per lin.ft., 4 in. tile, $0.16 per lin.ft. and catchbasins, $30 each. Total cost about $80,000.

★**Ont., Mimico** — Town let contract building 1¼ mi. concrete pavement, 18 ft. wide, including curbing and sewering, to Archibald & Wright, Toronto. About $80,000, and $5000 for rental of equipment plus $3000 profit.

★**Ont., St. Thomas**—City let contract to Standard Paving Co., Central Chambers, Ottawa, paving 20,000 sq.yd. with asphalt on 6 in. concrete base, at $3.35 per sq.yd., 10,000 lin.ft. concrete curbing and guttering at $.86½ per lin.ft. and paving between tracks at $3.73 per lin.ft. Total cost about $45,000. Noted June 5.

Railways

PROPOSED WORK

Louisiana—Pub. Belt. R.R., City Hall, New Orleans, plans to sell $600,000 bonds to extend line. A. F. Barclay, engr.

California—E. F. Stahle, chn. com. transportation of chamber of commerce of La Jolla, has announced that arrangements have been made for financing construction of electric car line at La Jolla. It is planned to take over present line of Bay Shore R. R. which connects with Point Loam Electric R. R. at Ocean Beach and runs through Mission Beach, and build new 4½ mi. line, using 60 lb. rail, which is to be operated as an adjunct of San Diego Electric Ry., now operating Point Loma line.

Railways (Continued)

Nova Scotia—C. B. Brown, ch. engr. Canadian Natl. Rys., Moncton, N. B., soon lets contract grading 9.13 mi. for double-track line from Springhill to Maccan, about $180,000; also 7.57 mi. for additional main line from Truro to Belmont, about $249,000.

New Brunswick—C. B. Brown, ch. engr., Canadian Natl. Rys., Moncton, soon lets contract grading 3.35 mi. cut-off at Moncton Yards, involving about 150,000 cu.yd. clay. About $75,000.

Quebec—C. B. Brown, ch. engr., Canadian Natl. Rys., Moncton, N. B., soon lets contract grading 4.70 mi. for double-track diversion, between St Rosalie and Charlotte. About $57,000.

Ontario—W. F. Tye, engr., Montreal, submitted report to officials of Canadian Pacific Ry., Windsor St. Sta., Montreal, and Grand Trunk Ry., McGill St., Montreal, for interswitching tracks of two lines at Owen Sound, railway stations of which are on opposite sides of Sydenham River. About $100,550.

PRICES AND CONTRACTS AWARDED
(★Indicates award of contract)

★**Ohio**—Cuyahoga Co. let contract building spur track in Cleveland to connect with Lake Shore R.R. tracks, to R. E. Carey Constr. Co., 1500 West 112th St., Cleveland. About $10,000.

Excavation and Dredging

PROPOSED WORK

Tex., San Antonio—Channel—City election July 26 to vote on $200,000 bonds to build river channel. H. Helland, city engr.

Colo., Las Animas—Dam—Whiting and Laird, archts., Exch. Bldg., Denver, soon let contract building Muddy Creek dam, 25 mi. south of here, for Mutual Carey Irrigation Co., Exch. Bldg., Denver. Work involves 620,000 yd. fill, 50,000 yd. additional earth work and 1330 cu.yd. concrete.

Ore., Bandon—Dredging—Port of Bandon plans to remove rocks from jetty to include dredging, blasting, etc. About $127,000. Federal Government will bear one-half cost.

Cal., Berkeley — Dredging — See "Miscellaneous."

B. C., Victoria—Canal—Provincial Government soon lets contract building and completing 8 mi. irrigation canal from point of diversion on Okanagan River, with excavations for structures as may be necessary. About $100,000. E. A. Cleveland, c/o Dept. Lands, Victoria, engr.

BIDS DESIRED

N. J., Atlantic City—Excavation—See "Miscellaneous."

Minn., Duluth—Ditch—See "Streets and Roads."

Mont., Columbus—Drainage—Until July 20, by H. M. Ray, drain comr., Stillwater Co., building lake drain, involving 59,130 cu.yd. open canal, 20,440 cu.yd. trenching and 3 mi. 20 in. tile. H. C. Rothwell, Columbus, engr.

B. C., New Westminster — Dredging — Dept. Pub. Wks., Ottawa, Ont., receiving bids dredging north arm of Frazer River, between here and Marpole.

B. C., Powell River—Dredging—See "Miscellaneous."

PRICES AND CONTRACTS AWARDED
(★Indicates award of contract.)

★**Mo., Grant City**—Drainage—Worth Co. D. D. No. 1 let contract building 13 mi. drainage ditches, involving 993,000 cu. yd. earth excav., to Reise Constr. Co. 320 North 15th St., Kansas City. About $119,000. Noted May 1.

★**Ore., Portland**—Channel—Pub. Dock Com. let contract digging channel from Columbia Slough to Columbia River, to pacific Bridge Co., foot of Salmon St., $309,450. Noted July 3.

★**Ont., Cobourg** — Dredging — Dominion Government, Ottawa, let contract for 57,000 cu.yd. excav., here, to Ottawa Contractors, Ltd., Elgin St., Ottawa, $15,390.

Industrial Works

PROPOSED WORK

Mass., Holyoke—Hall's Dairy, Inc., 11 Brooks Ave., plans to build 2 story 60 x 75 ft., brick building, rein.-con. flooring, concrete foundation on Sargeant St. About $40,000. G. P. B. Alderman & Co., People's Savings Bank Bldg., archts.

Mass., Palmer—Clinton-Wright Wire Co., Hammond St., Worcester, plans to build 1 story plant here. About $100,000. Architect not selected.

Mass., Turners Falls—Esleeck Mfg. Co. plans to build 5 story brick addition to factory here. About $75,000.

R. I., Westerly—Arnold Rudd Co., 318 Bank St., New London, Conn., plans to build warehouse here. About $40,000.

R. I., Woonsocket—McClintock & Craig, engrs., 33 Lyman St., Springfield, Mass., soon receives bids building 1 and 2 story 60 x 120 ft. brick and concrete dyeing and finishing plant for Gold Mark Knitting Co., Water St. About $300,000.

Conn., Bridgeport—Schwerdtle Stamp Co., 41 Cannon St., plans to construct 3 story, 30 x 60 ft. manufacturing building, brick and concrete, rein.-con. flooring, concrete foundation, on Cannon St. About $25,000. Private plans.

Conn., Middletown—New York, New Haven & Hartford R.R. plans to rebuild round house at freight yard here. About $25,000. E. Gagel, New Haven, ch. engr.

Conn., New Haven—S. D. Woodruff & Sons, Orange, soon receive bids building 1 story, 80 x 140 ft. garage with wing 40 x 80 ft., concrete and brick, rein.-con. flooring, concrete foundation, on Whalley Ave., here. About $35,000. Shiner & Appel, 185 Church St., archts.

Conn., New London—M. Rosoff, 90 Park St., soon receives bids building 1 story steel and brick garage, rein.-con. flooring, concrete foundation, on College St. About $30,000. J. Weinstein, 6 Church St., New Haven, archt.

N. Y., Brooklyn—I. Canry Mfg. Co., c/o W. T. McCarthy, archt., 16 Court St., soon receives bids building 3 story brick and steel factory, rein.-con. flooring, concrete foundation, on Belmont and Georgia Aves. About $200,000.

N. Y., New York—H. O. Chapman, archt., 334 5th Ave., receives bids about July 12, building 7 story, 50 x 100 ft. brick and steel publishing house, brick foundation, for Street & Smith, 161 West 15th St. About $125,000.

N. J., Trenton—Freihofer Baking Co., Indiana and 20th Sts., Phila., plans to build bakery, here. About $300,000. Architect not selected.

Pa., Phila.—A. Finmore, 902 South 10th St., soon lets contract building 4 story, 30 x 40 ft. brick, steel and timber warehouse. H. D. Dagit, 4527 Pine St., archt.

Pa., Pittsburgh—Basic Mineral Co., 834 Columbus Ave., having plans prepared by Leffler & Schubert, archts., North Side, building 2 story, 75 x 75 ft. rein.-con. and brick addition, rein.-con. flooring, concrete foundation, on Columbus Ave., to include storerooms, laboratory, mill and electric furnace. About $25,000.

Md., Baltimore—W. B. Cassell & Co., 1027 South Howard St., having plans prepared for 4 story, 35 x 145 ft., rein.-con. warehouse, rein.-con. flooring, concrete foundation, on Cross St. and Key Highway. About $60,000. H. F. Doelman, 507 North Charles St., engr.

Md., Baltimore—Genl. Coffee & Tea Co., Light and Lee Sts., having plans prepared by G. R. Callis, Jr., archt., 55 Knickerbocker Bldg., for 5 story, 83 x 197 ft., rein.-con. and brick warehouse, concrete foundation. About $65,000. J. Posey, 925 Fidelity Bldg., consult. engr.

Md., Baltimore—W. Schluderberg & Son, 4th and Bank Sts., having plans prepared by C. B. Comstock, archt. and engr., 110 West 40th St., New York City, for first unit of packing plant, to be 4 or 5 story, rein.-con., concrete foundation, on East Baltimore St. between 5th and 7th Sts., About $250,000. Total cost $500,000.

Md., Cumberland—Amer. Cellulose Mfg. Co. preparing plans for 1 and 2 story, concrete, iron and steel additions to plant. About $1,000,000.

Md., Curtis Bay (Baltimore P. O.)—C. S. Walton Co., 3rd and Vine Sts., Phila., plans to build factory on 10 acre site at junction of Cabin Branch and Baltimore & Ohio R.R., here. Cost between $40,000 and $50,000.

Md., Highlandtown (Baltimore P. O.)—Jones & Lamb Co., Pennsylvania and Fulton Aves., soon lets contract remodeling plant of Monumental Brewery Co. and constructing several rein.-con., steel and brick buildings, rein.-con. flooring, rein.-con. foundation, on Lombard St. About $500,000. This item incorrectly noted in June 19 issue.

W. Va., Parkersburg—Parkersburg Rig Reel Co. soon receives bids building 1 story, 105 x 220 ft., brick and steel foundry. About $75,000. Day & Zimmerman, 611 Chestnut St., Phila., archts. and engrs.

La., New Orleans—Charity Hospital, Tulane Ave., having plans prepared by A. W. Lewin, engr., c/o Assn. Commerce, 635 Common St. for 2 story, concrete, steel and brick power house, on Tulane Ave. About $90,000.

O., Akron—Swirsky & Miller, archts., Peoples Trust & Savings Bldg., soon let contract building 3 story, 50 x 110 ft., brick and steel factory and warehouse, rein.-con. flooring, concrete foundation, for Akron Mattress Co., Railroad and Miami Sts. About $80,000.

O., Cleveland—Arjo Realty Co., 214 Williamson Bldg., plans to build 2 story, 80 x 109 and 100 x 405 ft., concrete, steel and brick addition to factory, at 6545 Euclid Ave. About $250,000. Architect not selected.

O., Cleveland — Cleveland Illuminating Co., Illuminating Bldg., soon lets contract building 1 story, 70 x 167 ft., concrete, steel and brick garage, at 6500 Cedar Ave. About $60,000. P. H. Cobb, Illuminating Bldg., archt.

O., Cleveland—Cleveland Metal Products Co., 1141 Ivanhoe Rd., having plans prepared by G. S. Rider, archt., 612 Century Bldg., for 1 story, 29 x 54 x 12 ft. storage building, cost $60,000, and 3 story, 60 x 90 ft. addition to assembling room, $120,000; concrete, steel and brick. Noted July 3.

O., Cleveland—H. E. Hedges, 428 Guardian Bldg., had plans prepared by C. S. Griese, archt., 1321 West 85th St., for 1 story, 50 x 250 ft., concrete, steel and brick garage, rein.-con. flooring, at 2040 East 105th St. About $60,000.

O., Cleveland—Gabriel Mfg. Co., 1407 East 40th St., plans to build 2 story, 40 x 151 ft., concrete, steel and brick addition to factory. About $30,000. Architect not selected.

O., Cleveland—Peerless Motor Car Co., East 93rd St. and Quincy Ave., having plans prepared by W. J. Carter, archt., 723 Illuminating Bldg., for 1 story, 45 x 160 ft. addition to machine shop, cost $25,000, also 3 story, 40 x 120 ft., addition to assembling room, $40,000; both concrete, steel and brick. Noted July 3.

O., Cleveland—Theuner Norton Provision Co., West 65th St. and Stock Ave., had plans prepared by F. J. Anders, archt. and engr., 430 Erie Bldg., for 3 story, 32 x 50 ft., concrete, steel and brick addition to factory. About $30,000. Noted July 3.

O., Columbus—Timken Roller Bearing Co., Dueber Ave., Canton, plans to build branch plant here, to cost between $1,000,000 and $1,500,000. Main building to be 300 x 500 ft., modern saw-tooth type construction.

O., Dayton—Dayton Steel Co. purchased plant on Howell and Parker Sts., and plans to enlarge same for manufacture of fabricated structural steel and bridges. About $35,000.

O., Dayton—Dayton Eng. Laboratories Co., East 1st St., soon receives bids building 6 story, 200 x 200 ft., rein.-con. and brick addition to factory, rein.-con. flooring, concrete foundation. About $250,000.

O., Dayton—Gem City Auto Sales Co., Monument and Stratford Sts., plans to build 2 story, 60 x 130 ft., rein.-con. and brick garage and sales building, rein.-con. flooring, on Monument St. About $100,000. Architect not selected.

O., Dayton — Mitchell-Ite Explosive Co., 808 Dayton Savings and Trust Bldg., plans to build plant on tract south of here, to consist of several 1 story buildings. About $100,000.

Mich., Detroit—Amer. Seed Co., Fort and 21st Sts., having plans prepared by B. C. Wetzel & Co., archts., 2317 Dime Bank Bldg., for 5 story, 40 x 60 ft., factory and 2 story, 24 x 76 ft. garage, rein.-con., brick and steel, rein.-con. flooring, concrete foundation.

Mich., Detroit—Swedish Crucible Steel Co., Butler St. and Grand Trunk Ry., having plans prepared by Raseman & Freer, archts., 1302 Penobscot Bldg., for 1 story, 240 x 240 ft., brick and steel factory, rein.-con. flooring, concrete foundation, on Conant Ave.